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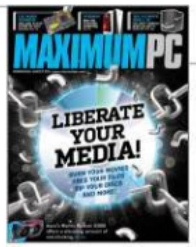

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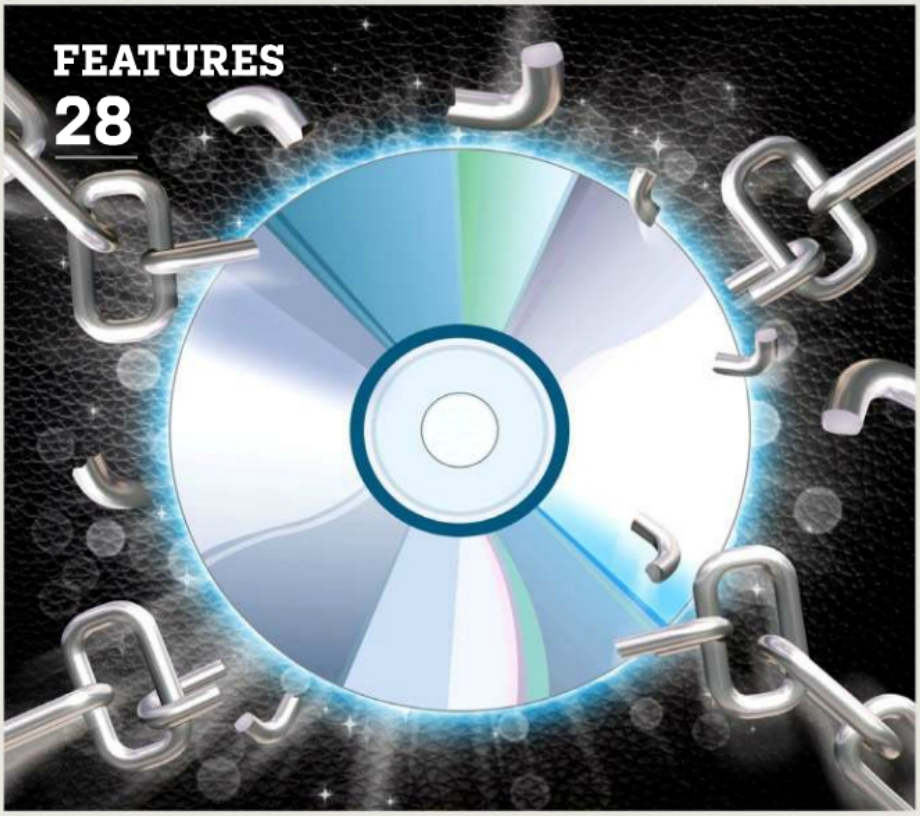

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Gordon Mah Ung

MOBO MEMORIES

I CAN STILL remember the first ATX motherboard I bought in the 1990s. I had acquired a blazing-fast 166MHz Pentium MMX part (I had just missed out on the top-end 200MHz Pentium MMX by a few minutes) and needed a mobo to go with it.

Being a complete newb, I went to the Local Computer Store and purchased an Intel motherboard based on that new technology that was going to change the world: Universal Serial Bus. I knew USB was the thing to have, and the cool blue box said "USB support." Little did I know what "USB support" meant. The board I in my sweaty hands apparently had the capability, but apparently there was no reason to include the actual ports in the package. Yes, USB support technically, but it had solder points where you would normally find the port stack.

The newb in me figured that was how USB was implemented. I assumed the deal was that at some point the consumer would buy an upgrade kit, and then solder it on to add the capability. That isn't how it happened because we know that even back in the 1990s, motherboard vendors didn't expect you to solder add-on features to your motherboard. Instead, what I probably got was some odd-duck OEM board that the PC maker decided to save $3 on by not including the USB ports. And why bother, since the newfangled technology didn't really go anywhere for another two years. Even worse, even though the board had no ports, the I/O Shield was punched out for the two USB ports it should have had. That meant for the next few years, every time I worked on my PC, that empty spot would mock my newbness for making a terrible motherboard choice.

You could be damned sure my next motherboard purchase got much more intensive research. That board was a good pick, too. I selected the famous Asus P2B using Intel's warhorse of a chipset: the 440BX. That P2B would carry me through multiple CPU (I started out with the cheaper 66MHz FSB 266MHz Pentium II part) and GPU upgrades and housed my dual Voodoo2 boards for years. And yes, it had USB ports.

I bring this up because with the arrival of Intel Z97 chipset, it's again "safe" to buy an LGA1150 motherboard. Even better, today's motherboards are far more feature-packed than they ever were in the 1990s, and cheaper to boot. I remember paying about $260 for that first USB-less board, and close to that for my P2B. Neither of those boards had Ethernet nor integrated audio, much less the capability or performance of today's motherboards.

You still have to make your hard choices between SATA Express or M.2 port, and how many PCIe slots you want, but at least you can buy knowing that today's motherboards are a world apart from what enthusiasts had access to just a decade or so ago.

Gordon Mah Ung is Maximum PC's Editor-in-Chief, senior hardware expert, and all-around muckraker.

↘ submit your questions to: comments@maximumpc.com

THE NEWS

AMD Bets Big on ARM

ARM and x86 to co-exist

IF YOU WANT MORE proof that the end is nigh and Gozer the Gozerian is about to spawn, you don't have to look much further than cats and dog sleeping together or ARM and x86 cohabitating.

Yet that's the future that AMD is headed toward with its new Project SkyBridge chips. Aimed for release sometime next year, Project SkyBridge will be a pair of 20nm socketed System on Chips. One—wait for it—will be based on ARM's Cortex A57 architecture, and the other will use AMD's next-generation Puma+ cores, which will be x86. Both will be pin-compatible, so in theory, their motherboards would be interchangeable. While AMD didn't detail too many specifics of its x86 Puma+ cores, it will use Graphics Core Next graphics, Heterogeneous System Architecture and AMD Secure Technology. Puma+ won't be competing with the high-end desktops in its SoC form, though.

Analyst Patrick Moorhead of Moor Insights & Strategy said AMD's push on ARM isn't a sign that the company has given up on x86, either. "I don't think AMD is turning its back on x86," he said. "ARM just has a much broader hardware ecosystem in certain areas, so AMD can more easily license IP that fits nicely into an SoC."

Still, this isn't the only ARM project currently cooking at the company. AMD also announced it's working on a high-performance, low-power 64-bit ARM chip code-named K12. This chip won't be available until 2016, but the company expects K12 to target what it and many others see as the next war front: servers. It's no small game, either. Analysts are forecasting that server sales will reach $85 billion by 2017.

Servers today are largely dominated by x86 chips, which occupy more than 80 percent of the pie chart. Intel has the lion's share of the x86 servers, with AMD's star having long faded since the glory days of the first Opterons. That's perhaps why AMD thinks it can do an end-run on Intel as a go-to company for performance ARM chips. While many don't see ARM as competing at all with Intel's parts purely on performance, others see the future of data centers growth more in terms of performance-per-watt. In a world where a data center's performance is gated not by the amount of CPUs that can be packed into it but how much electrical power it can access to run it, ARM is seen as the answer. An ARM chip, for example, might offer only a fifth the performance of an x86 chip, but if it consumes, say 1/20th of the power, you can run more ARM chips.

That's what AMD is betting on with its push into servers. As proof of its commitment, AMD also demonstrated its 64-bit Opteron A1100 based on ARM, previously code-named Seattle. The proof-of-concept demo ran Red Hat's Fedora Project version of Linux.

AMD actually disclosed Seattle in January and said at the time that the 64-bit ARM part offered two to four times the performance of its Opteron X-series (an SoC server chip based on four Jaguar x86 cores) while using less power. Moorhead said one thing people need to understand is performance and power consumption. "Instruction sets are independent of performance and power consumption. It's the design that matters," Moorhead said. "Just as ARM instruction set has no power advantage, it also doesn't have a performance disadvantage. Someone could theoretically build a very high-performance ARM chip—and they are, like APM. You still get back to R&D spend, because to get all that performance, you need to spend money developing it."

–Gordon Mah Ung

AMD's future Opterons will let vendors drop either an ARM or x86 CPU into the same socket.

Acer Has 4K G-Sync

Acer says it will be the first out of the gate with an Ultra HD monitor that also includes Nvidia's long-awaited and elusive "G-Sync" technology. G-sync essentially synchronizes the refresh rate between the video card and monitor, which greatly reduces the appearance of tearing and stuttering at sub-par frame rates of say, 36fps. Such technology could be quite handy on the new Acer XB280HK, which will boast a resolution of 3840x2160. Unless you're running multiple GPUs, you won't be breaking high frame rates on newer games. Acer didn't disclose pricing on the 28-inch monitor, but said it would begin selling by this summer. Although announced last October, panels equipped with G-sync have been extremely difficult to locate. **–GU**

Steve Ballmer Buys LA Clippers

Steve Ballmer, former head of Microsoft, is moving on from developers, developers, developers to ballers. Right before this issue went to press, he inked a deal to buy the Los Angles Clippers from embattled owner Donald Sterling for a cool $2 billion. Fellow Microsoft colleague Paul Allen bought the Portland Trailblazers in 1988, so there is some precedent. Since Ballmer is worth an estimated $20 billion, he should have the liquidity necessary to buy the Clippers, who have been valued at $1 billion. He told the Wall Street Journal that he did not intend to move the team to Seattle, which has been missing an NBA presence since the Supersonics went to Oklahoma in 2008 and became the OK City Thunder. **–TM**

Google Fiber Helps Netflix

Despite an increasing number of Internet service providers lining up behind Comcast for a whack at Netflix's money piñata, Google is bucking the trend and not charging the video-streaming service a dime for the privilege of accessing its Google Fiber customers at advertised speeds. The company even offered space in its data centers for Netflix's content servers (and Akamai's, for that matter), because having them on-site reduces network latency. Google even covers the power consumption. Google Fiber already offers integrated Netflix streaming, at Super HD (aka 4K) when available, so perhaps having Netflix itself built-in is the next logical step. We look forward to the day that Google Fiber goes national. **–TM**

Tom Halfhill Fast Forward

WINDOWS 8 WORKAROUNDS

MY FORCED SWITCH to Windows 8.1 broke some vital software that worked perfectly on Windows XP. Luckily, I've found workarounds—and they might save your software, too.

Often, Windows 8.1 simply refuses to run an old installer. In other cases, the installer seems to work, but the installed application won't run. To make Windows 8.1 more cooperative, you'll need your old system and some persistence.

The first victim I rescued was an old version of Adobe Photoshop. The installer balked, so I bypassed it by copying all the installed files from my XP system to my new system. Then I opened the Properties window for the Photoshop executable file, chose the Compatibility tab, and selected "Windows XP Service Pack 2."

Photoshop still failed to launch but named a DLL file it couldn't find. I located the DLL in the Windows folder of my XP system and copied it to my new system. To avoid possible conflicts, I put the DLL in the Photoshop folder, not the Windows folder. Usually, programs look for their DLLs locally before searching elsewhere.

When Photoshop failed to open again, another error message named a different missing DLL. As before, this one was in the Windows folder of my XP system. After I copied it and made another try, Photoshop said it couldn't find yet another DLL. So I found and copied that one. After six iterations of this process, Photoshop finally launched. Now it runs fine, except it needs administrator-level permission before it opens, probably because it's not officially logged in the Windows registry.

I've used the same solution to salvage other vital programs that Windows 8.1 rejects. Sometimes it doesn't work when I copy the software to Program Files, so I created a desktop folder called Programs for those cases. Persistence pays off!

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

Thomas McDonald
Game Theory

TITANFALL DESERVES A LITTLE PC LOVE

WHEN IT WAS RELEASED, *Titanfall* was dismissed as *Call of Duty: Robots*, thanks to a complete failure of the imagination on the part of reporters. See, it's a multiplayer shooter developed by people who worked on *Modern Warfare*, so let's write it off with a cutesy log line and move along.

The *CoD* comparison has absolutely opposite effects, depending on platform. Tag something as *CoD: Robots* and the Xbox players will line up at midnight. Say the same thing to PC gamers, however, and many of us will return to *DOTA* or *Elder Scrolls Online*. And that seems to be the case here: PC gamers are not giving the game much love, and developer Respawn Entertainment is returning the favor by dropping modes and app support from the PC version.

I really hate it when mom and dad fight like this, because *Titanfall* is the first fun multiplayer shooter I've enjoyed since... gosh, was it really *Battlefield: Bad Company 2*? Crikey.

And *Titanfall is fun*. It offers a great rewards structure and makes the player feel powerful and important. Despite an introduction/tutorial that utterly fails to convey the true nature of the game—making it look like, well, *CoD: Robots* with lots of wall-running—I stuck with it and found one of the real gems of PC action gaming.

It's hard to really put a finger on what works so well, but the game just makes you feel good. The AI characters bend the curve just right, so less-skilled players have something to do. There's a real sense of power behind the mechs and weapons, and pilots and Titans are equally fun to play due to their distinct qualities. Finally, the radio chatter, bots, and mission structure just make you kind of important, like you matter in this game world. Military shooters almost always begin with some kind of grim intro or "Listen up, maggots" training session designed to make you feel like a loser.

Titanfall is designed to make you feel like a tiny god in armor, and I like that a lot better.

Thomas L. McDonald is Editor-at-Large of Games Magazine.

Devil's Canyon Detailed

The clock-speed race may have died long ago, but Intel says it will break the 4GHz barrier with its Devil's Canyon CPU. Essentially a Haswell chip on steroids, the Core i7-4790K has a base clock of 4GHz and a turbo boost of 4.4GHz. Intel is pitching the unlocked Devil's Canyon as an enthusiast part, with a "polymer thermal interface material" and additional capacitors to smooth power delivery and aid in overclocking. The chip will retail for $339—same as the Core i7-4770K part. Intel also released the 3.5GHz Core i5-4690K without Hyper-Threading for $242, and with slightly less cache, too. **–GU**

Microsoft Confirms 'Windows 8.1 with Bing'

Hardware vendors competing against companies that sell low-cost devices loaded with Android or ChromeOS have been asking Microsoft for a long time to cut them a better deal, since Google's operating systems have no licensing fees, giving them a price advantage. Microsoft removed the licensing fee for devices with screens 9 inches or smaller, and now they're upping the ante with "Windows 8.1 with Bing." This one does not have a screen-size limitation, but it will be restricted to "devices from our hardware partners," which we take to mean desktops and laptops from Dell, HP, and the like. The only catch is that Internet Explorer on this device must use Bing as its default search engine. **–PC**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

GOOGLE'S SELF-DRIVING CAR
It has no steering wheel and maxes out at 25 miles per hour, but if can save us from the texting moron army, we'll buy two.

SKYPE'S UNIVERSAL TRANSLATOR
Microsoft unveils real-time language translation for its text and video chat program—no fish in your ear required.

SSD PERFORMANCE BOOST
Japanese researchers discover a software-based garbage collection method that could up speeds by 300 percent.

TRAGEDIES

TRUECRYPT CONUNDRUM
The makers of the popular encryption program suggest that their crypto keys have been compromised and shoos users elsewhere.

WATCH_DOGS PR STUNT
Someone thought it was a good idea to deliver a beeping, locked safe to a television news office without telling anyone.

IBM IN CHINA
In the wake of NSA revelations, the Chinese government advised its banks to shift away from using IBM products.

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Quinn Norton
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PRIVACY BADGER DON'T GIVE A COOKIE

IN THE AGE OF data tracking, sometimes it seems like everyone knows even more about you than you do. In one case, a dad got pregnancy marketing aimed at his teenage daughter. He yelled at the retailer, but it turned out they knew more about his family than he did. How?

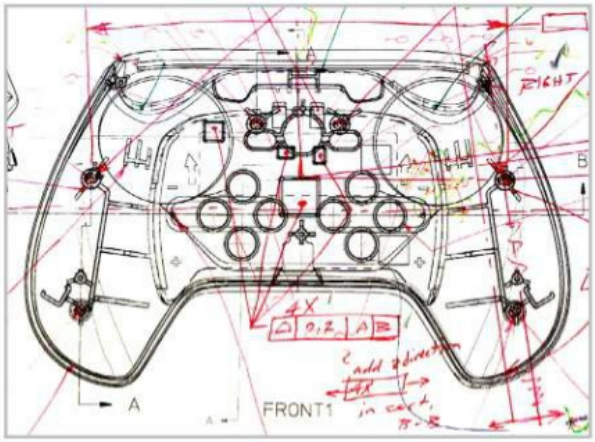
If they shopped online, it's easy to figure out. What advertisers do is put a small text file, called a cookie, on your machine and run Javascript in your browser, identifying you and what you're doing. They update their cookie anytime you visit a new site they partner with. This lets them build an extensive dossier on you, to try to sell you things. Looking at diapers? Here's an ad for rattles. Most of us accept ads as part of the web, but we don't get a choice about being monitored. The Do Not Track standard was made to fix this.

In principle, Do Not Track is great. People who are using the web can set a flag in their browser that communicates to advertisers that, as a privacy-conscious consumer, they are opting out of tracking and behavioral profiling on the web. In practice, hahahah LOLRIGHT. There's no legal or technical enforcement of Do Not Track yet, so it works as well as trying to politely excuse yourself from a mugging. Yahoo, Google, and Facebook all ignore it, which means you're tracked.

The EFF has released a tool to give the preference to not be tracked some teeth. Privacy Badger is a browser plug-in for the most popular browsers, including Chrome and Firefox. It blocks the cookies of advertisers that disregard your Do Not Track preferences, while allowing cookies required for page functionality. There are two nice things about using a tool like Privacy Badger. The first is not getting tracked. But the second is what we show the companies watching us: a badger of defiance.

Quinn Norton writes about copyright for Wired News and other publications.

Steam Machines, Controllers Delayed to 2015



In a blow to Steam Machine proponents, Valve said it's unlikely that it will release its Steam controller this year at all. Valve's Eric Hope disclosed on a community forum that implementing changes to the controller has meant the device is not likely to see the light of day until 2015, at this point.

The delay of the Steam controller also comes as a blow to the hardware partners who had lined up to show off Steam Machines at CES. Since Valve isn't allowing Steam Machines to be sold as "Steam Machines" without the official controller, those designs—now already six months old—will be at least a year old when Steam Machines are finally launched. Way back in January at CES, hardware partners told us that they hoped to have systems for sale within two months of the announcement. One OEM we spoke with said they were pretty unhappy about the delay and how Valve treats hardware partners.

"They keep delaying the controller—and in all honesty, they're operating like a true software-minded company. Just redesign, recode, relaunch if the community gives new feedback," said the OEM who asked not to be named. "I honestly think few if any companies have the luxury to do that over and over, except may be Apple and Samsung."

Perhaps more troubling is that there's no indication of when in 2015 Valve intends to release. Valve has already had to largely scale back its ambitions on the Steam controller. Its original form included a touch-enabled screen, but the company has since ditched that in favor of more traditional buttons. **–GU**

Don't Reg Hack XP, MS Says

XP may be dead, but clever souls discovered a registry line allowing the OS to still receive updates. Or maybe not. Microsoft says the registry change allows XP to install updates intended for Windows Embedded and Windows Server 2003—both of which are still receiving some security updates. "Windows XP customers also run a significant risk of functionality issues with their machines if they install these updates, as they are not tested against Windows XP. The best way for Windows XP customers to protect their systems is to upgrade to a more modern operating system, like Windows 7 or Windows 8.1," a Microsoft official told news site ZD Net. Um, OK. **–PL**

Oculus VR and Chuck E. Cheese Joining Forces

Part of the Chuck E. Cheese birthday experience is the Ticket Blaster, where you stand in a contraption the size of the phone booth and attempt to gather up as many chits as you can before time runs out. The tickets can then be turned in for prizes. It's a simple system that prepares children for life as a working stiff. The company announced that it was partnering with Oculus VR to use its Rift in a virtual version of the Blaster. In theory, this vastly multiplies the number of people who can do the Blaster dance in one day, so it's nice that someone is literally thinking of the children. **–TM**

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THE LIST

7 TECHNOLOGIES THAT HAVE MADE OUR LIVES WORSE

7 SMART TVS

Slow-responding applications don't feel very smart.

6 GOOGLE GLASS

Having people glued to their phones at the dinner table was already bad enough.

5 TSA BODY SCANNERS

If we wanted the TSA to see us naked, we would have just shown up at the airport that way.

4 SMART METERS

What do you mean, we have to pay for exactly what we use?

3 PROPRIETARY CHARGERS

We always wanted to carry a separate charger for each and every electronic device while traveling.

2 RADAR GUNS

Becoming a municipality's cash cow isn't our idea of our tax dollars at work.

1 DRM

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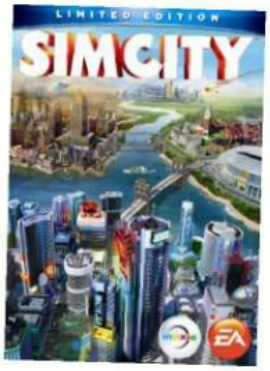

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HEAD TO

BY **TOM MCNAMARA**

Two EVGA 780 Ti Cards vs. One Radeon R9 295X2

Getting two graphics processing units (GPUs) on one video card is a time-honored tradition for enthusiast rigs. With this generation, AMD has gone with an integrated closed-loop liquid cooler (CLC) to keep its two R9 290X GPUs from getting crispy. Nvidia's dual-GPU card has yet to make an entrance, but two 780 Ti's linked together using SLI have roughly the same performance and price. If you're prepared to spend about $1,500, these two options are natural competitors.

The EVGA 780 Ti sandwiches a plate right on top of the PCB, to help transfer heat from its memory chips.

ROUND 1

Installation

Like the Asus Ares II before it, this 295X2 uses a CLC with a 120mm radiator and a 120mm fan. The most sensible installation point for the radiator happens to be where a case's rear exhaust fan usually goes. So, the exhaust fan has to be moved to the top. But if you're also using a CLC for something else in your system, that might not be an option. The 295X2 is also about 12.5 inches long, so it may be too beyond what your case can even handle. The 780 Ti cards, meanwhile, are relatively compact at 10.5 inches, and they have no radiators to wrangle. If you're using a small form factor case like the Corsair 250D or the Bitfenix Colossus Mini, though, a 295X2 is your only real choice at this price.

Winner: 295X2

ROUND 2

Performance

While both competitors are gorgeously engineered, beauty is only skin deep, so let's get right to the numbers. Out of the box, EVGA's two cards are assisted by a core clock speed of a little over 1GHz, which is an impressive 125MHz above the stock version. And we see the results of that borne out across the board. The advantage may be slight at times, but it's consistent. Then again, the AMD card has plenty of headroom for its own overclocking. The 295X2's liquid cooling allows it to run much cooler (and quieter) than a stock R9 290X. And you can bet that anyone dropping $1,500 on this beast is going to give OC'ing a whirl. And sure enough, we were able to bring it in line with EVGA's cards. We tried tweaking the 780 Ti cards as well, but their factory OC was already pretty aggressive, and we weren't able to get it substantially higher.

Winner: Tie

HEAD

A single large intake fan cools the 295X2's centralized voltage regulators, while two liquid-cooled Asetek heatsinks tackle GPU duty.

ROUND 3

Noise and Heat

Like the Ares II before it, the 295X2's CLC is beefy enough that the unit never gets above a mild hum, even when overclocked and looping benchmarks. Meanwhile, you can definitely tell when the 780 Ti pair go to work. With a tower case, the two cards are also stacked on top of each other, so the upper card sucks in heat blowing off the lower card. This heat puts a firm ceiling on the pair's ability to reach a stable overclock—their clock speeds need to match, and the top card becomes the weakest link in the chain. These EVGA cards also use a partial shroud, so a lot of heat is blown into the case. But anyone spending this kind of money is prepared for that, so the 295X's full shroud is not a big advantage. The 295X2's whisper-quiet operation gives it a slight edge, though.

Winner: 295X2

ROUND 4

Software

Both AMD's and Nvidia's packages have fine-grained performance settings, monitor calibration, and a comprehensive listing of your system hardware (helpful for troubleshooting, or sometimes just bragging rights). Nvidia's "GeForce Experience" software has ShadowPlay, which is some of the best hardware-accelerated video capturing that we've seen outside of broadcast-caliber programs that cost thousands of dollars and require training to even use properly. But GFE is free and streamlined for everyday use. Nvidia also tests a boatload of games and gives you one-click optimizations for all of them. AMD's "Gaming Evolved" software uses crowd sourcing to determine optimal settings, which can be just as good. AMD also has an interesting reward points system, stat tracking, and social media integration. Both companies are obviously working hard to win you over, but we have to give the edge to Nvidia for its low-overhead real-time video encoder.

Winner: 2x EVGA 780 Ti

ROUND 5

Customer Support

When you spend this kind of cheddar on your rig, you want to make sure that potential problems down the road will be taken care of without excessive costs or wasted time. EVGA's package is arguably the best in the business. For warranty support, you create an account on their site and transmit an image of your receipt. From there on, its serial number, place of purchase, and even time of sale will always be a few clicks away. You'll be notified of free bundled games that you may qualify for, and EVGA streamlines the request process. They also have a "Step-Up" program through which you can upgrade to a new EVGA card within 90 days of purchasing the original, and you pay only the difference. AMD's partners such as Asus and Sapphire have some high-quality performance tweaking software, but EVGA's overall package is impressive.

Winner: 2x EVGA 780 Ti

And the Winner Is...

This one was tight. Both camps deliver very well-engineered products and back them up with comprehensive software. The 780 Ti pair run faster at first, but they can't overclock much higher; the 295X2 can close the gap after a little tweaking, thanks to its nifty CLC. In the end, it may come down to personal taste. For us, the quiet and cool operation of AMD's card is a thing of beauty, so the photo finish belongs to the **Radeon 29 295X2**.

(Continued on next page)

HEAD TO HEAD

Double Your Money, Double the Fun?

With Head 2 Head, we try to get two products that are as comparable as possible. But as this issue went to press, Nvidia did not have a dual-GPU card that it could deliver to us. The Titan Z had been announced, but its future appeared murky. That would make the 295X2 a winner by default, but two single-GPU cards is still a worthy and popular comparison.

We also had to decide whether to use a stock 780 Ti or one customized by a vendor. Why would you bother with the stock unit? Well, that version has a "full shroud" around the card, so it ejects its hot exhaust out the back of the case. (That's even how the 295X2 is designed.) Most proprietary versions have a partial shroud. You get a larger number of (potentially bigger) fans, which keeps the chips cooler. A stock 780 Ti will climb quickly to 82 degrees Celsius, at which point the card is designed to prevent the chip from getting any hotter. This means the fan can get pretty loud. Proprietary cooling like EVGA's "ACX" design uses larger fans, and more of them, to lower the noise profile, but it still gets up to a dull roar.

Should you care, though? If you're gaming with headphones, arguably not. If you're using a nice speaker system and playing a loud shooter, arguably not. But at $1,500 or so, we'd argue that you have a reasonable expectation of low distraction, and the enthusiast experience isn't always full of explosions and gunfire. We also feel an obligation to account for a variety of users, some of whom are more sensitive to system noise than others.

There was one thing about these tests that we couldn't readily account for, and that was the 780 Ti's performance at Ultra HD screen resolutions. It's taken as common knowledge among enthusiasts that you need a sizeable amount of video RAM to play games at 3840x2160 pixels. But across our benchmarking phase, the difference wasn't as great as we had expected. We suspect that some testers may be maintaining 4x multisample anti-aliasing, or more. But this method of reducing jagged edges on screen just isn't needed when your pixel density is this high, so the extra 1GB of VRAM on the 295X2 isn't a clear advantage.

Lastly, Nvidia has a reputation for providing multi-GPU support for specific games faster than AMD does. And we noticed that *Batman: Arkham Origins* didn't appear to recognize the 295X2's second GPU when using the 14.4 beta drivers. And performance still wasn't up to snuff with the final 14.4 drivers. This is also an Nvidia-backed game, though, so AMD might not have had access to it until after release. Nvidia had some obstacles of its own with the AMD-backed *Tomb Raider* reboot, so there's some give-and-take depending on the game.

BENCHMARKS

	AMD Radeon R9 295X2 (2560x1600)	2x EVGA GeForce GTX 780 Ti (2560x1600)	AMD Radeon R9 295X2 (3840x2160)	2x EVGA GeForce GTX 780 Ti (3840X2160)
Driver	14.4 final	337.50	14.4 final	337.50
Hitman: Absolution (fps)	79	79	75	75
Crysis 3 (fps)	56	48	42	43
Tomb Raider (fps)	50	56	53	56
Metro: Last Light (fps)	48	53	26	27
Batman: Arkham Origins (fps)	90	103	89	113
Thief (fps)	62	84.2	62	60
Unigine Heaven 4.0 (fps)	65.1	83.5	32	44
3D Mark Fire Strike	15656	16830	N/A	N/A

Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an Asus Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8.1. All games at 2560x1600 use 4xMSAA, while all games at 3840x2160 tests use no anti-aliasing, except for *Metro: Last Light*.

CyberPower recommends Windows

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DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Cooling Colors
> Movin' on Up
> Where's My SSD?

Pink Problems

I'm running a Core i5-3570K on an ASUS P8Z77-V LK LGA 1155 mobo with a Gigabyte GeForce GTX 670, Corsair H100i cooler, and OCZ 750W PSU all packed into a Corsair Obsidian 650D case. My issue is with the Corsair H100i cooler. When it was new, the logo on the cooling unit glowed blue, but after a few months it turned a bright pink. Everything seems to be working properly, fans running, etc., but the CPU seems to be running warm. I emailed Corsair support several times, and after a month they sent me an RMA form with no explanation. I don't want to return the unit if I don't have to. I just want to know if the color change is normal. Does the Doc know?

—John Ilasenko

THE DOCTOR RESPONDS: Congratulations, John, the pink glow means you're pregnant!

Actually, the Doc has run a Corsair H100i in the Lab in the past and didn't experience this problem, but there are some things to keep in mind. First, on the H100i you can change the color of the logo on the water block by installing and tweaking the Corsair Link software. It can be changed, for example, based on the chip's temperature.

You also need to attach the included USB cable to a header on the mobo. So, the first step would be to install the software and see if you can change it to green. It's possible the fan speeds on the unit are running at lower temps, which could be raising the temperature of the chip and trigger the change to pink. The good news is that if you install the Corsair Link software, you can also tweak the fan and pump speeds to your liking, along with the colors.

The Corsair Link software lets you change the color or the H100i's RGB LED on the water block, but by default it should not be pink.

Wi-Fi Slow Lane

I just bought an HP 210 GG1 laptop and the connection speed was bad. I was pleasantly shocked when the support tech replaced my Intel Wi-Fi drivers and suddenly we were able to move at the speed of light through the Internet. Why would replacing drivers less than six months old make such a huge difference in the Intel dual-band N-7260 performance?

—Art Hudson

THE DOCTOR RESPONDS: It's hard to say specifically what was causing your issues, Art, but when we hit Google to see if others were having problems with that wireless adapter, we did indeed find a thread on Intel's forums where a representative said they are "working on these issues," and he was speaking of the N-7260 wireless card. In your case, it sounds like Intel fixed them eventually, so that's good news. The key take-away, though, is that updated drivers can make all the difference in the world, even if the driver you're using is just six months old. That's a lifetime in the GPU world, but certainly shouldn't make that much difference for a wireless adapter. However, it's important to note that 802.11ac is now coming online, and we imagine wireless adapter manufacturers like Intel and Broadcomm as well as router companies will be issuing new firmware and drivers semi-regularly in order to coax maximum performance out of the new wireless standard, so always keep your drivers up to date. If you are too busy to check them manually, just download the free program Slim Drivers (www.slimwareutilities.com) and let it do the checking for you every month or two. We generally prefer to install drivers from the hardware maker directly, as OEMs tend not to issue new drivers until they can test as well, which usually takes a long period of time—or never happens at all.

↘ submit your questions to: doctor@maximumpc.com

Integrated Blues

I built a computer two years ago, but it won't play new games like *Titanfall*. I have an Asus Maximus IV Gene motherboard, two Corsair Force SSDs striped in RAID 0, 8GB of DDR3/1866, and a 3.5GHz Core i7-2700K overclocked to 4.2GHz on Windows 7 Home Premium. I have been using the onboard graphics but it's not working for these games. I need to know what video card you would suggest for the least amount of money. I have had the best results in the past with Nvidia cards and was thinking of a GeForce GTX 780 Ti card, but I live 100 miles away from any decent electronics store so I want to get it right the first time.

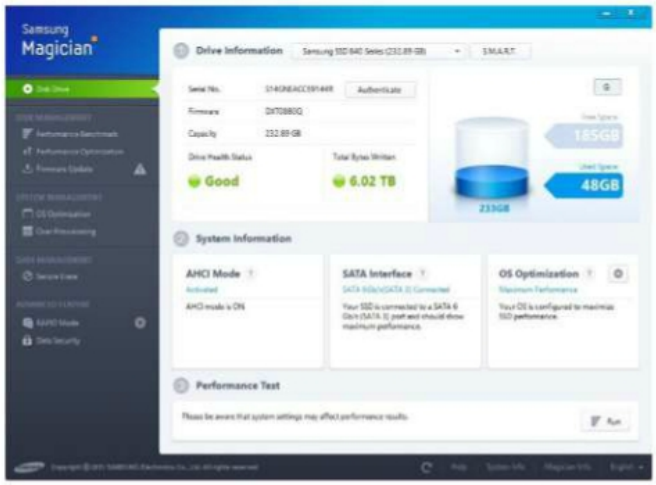
—Kim Wofford

THE DOCTOR RESPONDS: That's one sweet system you have there, Kim, and you are doing it an injustice by running onboard or integrated graphics. The graphics chips included on motherboards are for running games like *Farmville* or *Peggle*, not *Titanfall*, and don't even think about a gnarly shooter like *Metro 2033* or *Battlefield 4*. Your suggestion of the GTX 780 Ti is certainly excellent if you have that kind of cash, as that's a $700 GPU. You can save $200 by going with a GTX 780, which is about 10 to 15 percent slower, but still fast enough for 2560x1600 gaming on a 20-inch monitor with every detail set to maximum. If you're using a 1920x1080 panel, a GPU like the GTX 780 Ti is a little overkill, but will deliver more than 100fps in most games, and last you a very, very long time, so it's not a bad upgrade as long as money isn't an issue. One other thing to keep in mind is that you'll need at least a 600W PSU with two six-pin PCIe connectors to power the GPU. Also, since you have an Asus Gene microATX motherboard we're assuming you are running a smaller case, so make sure whatever case you have can handle an 11-inch GPU.

SSD Disappearing Act

I am having a wee problem with a Samsung PM830 SSD I bought on eBay. I followed all of *Maximum PC*'s directions for installing the SSD, yet when I run Samsung Magician, it says, "No Samsung SSD could be found." So, I'm unable to update firmware. Can you help me figure this out? I'm running a Gigabyte MA785GM-US2H Rev 3.3 board with latest BIOS F12f (beta), AMD Phenom X2 CPU, and 4GB of RAM. The Samsung Data Migration tool worked perfectly, and the BIOS is set for AHCI.

—Andrew Curzon



The Samsung Magician software lets you examine your drive, update firmware, secure erase it, and more. But it won't work on OEM Samsung drives.

THE DOCTOR RESPONDS: You may be out of luck, Andrew. Samsung's Magician software only supports retail versions of its drives. Drives sold to OEMs or PC makers are not supported. From what the Doc can tell, the PM830 is the OEM version of the Samsung 830 drive (the predecessor to the 840 drive), so Magician won't work on it.

For what it's worth, the reason the software doesn't see it and won't let you update the firmware is because whatever company originally sold that SSD put its own firmware on the drive, along with other customizations unique to the manufacturer. If you really want to be able to update the firmware on a Samsung SSD, you will need to buy a retail drive.

Also, don't feel too bad about this, as OEM manufacturers typically wield very strict control over what drivers and firmware are installed on any piece of hardware that leaves the shop. They do this to cut down on support calls, and to be able to work with software and firmware they are familiar with instead of rogue updates from parts unknown. Our advice to you is to just use the drive as-is, as we are not aware of any show-stopping problems with the Samsung 830 that would require a firmware update.

Upgrading to SSD

I just completed a new build about four months ago, and I am now perplexed about adding an SSD to my system. The system I built is Intel-based with an Asus Z87 motherboard, Intel Core i7-4770K processor, a Western Digital Black 3TB hard drive, and runs Windows 7. When I built this system, I was on a strict budget, so it made sense to opt for storage capacity rather than the at-the-time, high-dollar SSDs. Now that prices have come down, I'm interested in installing an SSD. My question is whether there is a way I can install or move the OS onto the new SSD and remove it from the original C: drive, the WD 3TB, or do I have to start from scratch again?

—Gary Lark

THE DOCTOR RESPONDS: There is a way to move your OS to the new SSD and there's a way to remove it from the original drive, Gary, and there's also a way to start from scratch, so it's up to you how you want to proceed. Most retail SSDs include drive-cloning software, so you can just attach the SSD and it will let you clone your boot drive to the SSD, no problem. The only question is, will your boot drive's OS installation fit onto the SSD? There's no way to just move your OS to the drive using cloning software, as it copies the entire partition, so that's a question you must consider. If your OS will fit on the SSD, clone away. However, there's a problem with this approach in that you really don't want all your data (games, music, movies, documents) on the SSD, because it will fill up way too fast. Sure, you can move those folders to your 3TB drive manually, but as you can imagine, things begin to get complicated when you're moving folders and OSes back and forth.

To keep it simple and ensure maximum performance from your SSD, we recommend just reinstalling your OS to the SSD (it will only take about ten minutes), then just change the links to Documents, Videos, Pictures, and Music in Windows to the respective folders on the 3TB drive. You can do this by right-clicking the folders and changing the Save Location. You can also move over the files from your desktop folder or anything else you have on the bigger drive. Once you're up and running and positive you have all the files you need, you can nuke your old Windows install on the 3TB drive from orbit.

When your "data" drive is a volume other than your boot drive, you need to change the pointers to data folders in your OS to the other hard drive by "adding" a new location.

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LIBERATE YOUR MEDIA!

Let freedom stream

You've likely moved onto Netflix or Hulu or some other direct streaming way to watch "television." But what about that massive collection of discs collecting dust in your AV room? Or the gigabytes of videos you want to share with relatives who haven't figured out how to watch videos on your photo-sharing site? Or the e-books for the reader that long ago died?

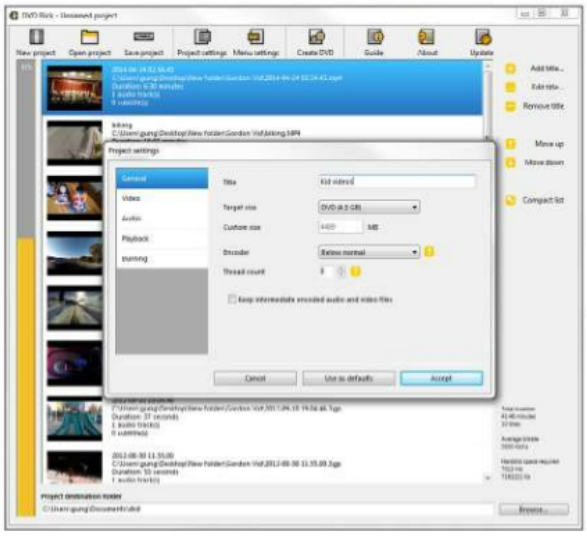
Today, there's simply no reason to let your valuable collection rot away in isolation. So to help you, we show you how to easily free the media you own use it where you want it—on your phone, on your tablet, streamed across your network.

BY **MAXIMUM PC STAFF** AND **DAVID MURPHY**

HOW TO...

PUT YOUR VIDEOS ON A DVD IN ONE MINUTE

The optical disc is dead. You know it, we know it, the American people know it. We also know that is a complete load of bantha dung. The truth is that even if you have moved to a fancy-schmancy cloud existence where you watch your entire transcoded video library at the coffee bar from your hybrid, convertible, solar-powered tablet, a lot of people are still living in the land of the DVDs and physical media. So when you want to show Aunt Peg the video of your kid snorting milk out of his nose, you have to burn it to DVD.



After you've added video via drag-and-drop, you'll want to change the title to something appropriate by clicking "Project settings" and selecting General.

1 DOWNLOAD DVD FLICK

Perhaps one of the easiest and cheapest ways to get this chore done is to use DVD Flick. This app is free and handles most of the messy chores of creating title menus, transcoding, and burning to disc that scare most people off after five minutes. As far as combo disc burning/transcoding apps go, DVD Flick is pretty much fire and forget.

First, download the program from www.dvdflick.net (it should link you to Sourceforge.net) and install it.

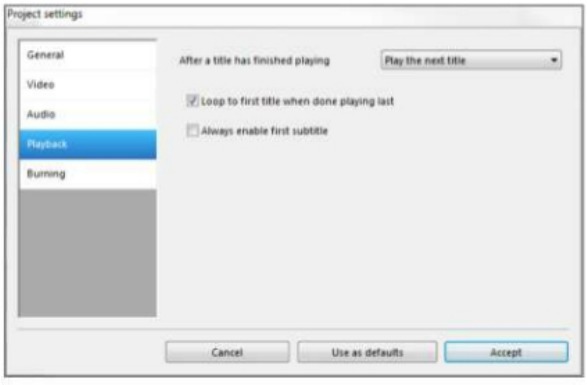
There's a basic functional menu system in DVD Flick that works adequately.

2 PICK YOUR VIDEOS

Once you've launched it, you can start a new project and begin to drag-and-drop to it. You can also select "Add title" and browse to the folder that holds the file you want DVD Flick to add.

The default for DVD Flick is to burn to a standard disc. If you want to burn a double-layer disc because Aunt Peg wants to see the hours of video at a higher bitrate, click the "Project settings" button; under General, change the target size. From there you can also pick how many threads you want the program to take during the encode and choose the encoder priority. If you intend for the disc to viewed on PAL, you can change that using the Video settings of Project settings.

If you're putting multiple videos on the disc, you can change how the disc plays back on a DVD player. By default, it will proceed to the next title, but you can click on Playback and change it return to menu or loop the particular title. Under Burning, you can also choose to create an ISO image rather than burn it directly to disc. This can be useful if DVD Flick has issues burning to your particular DVD burner.



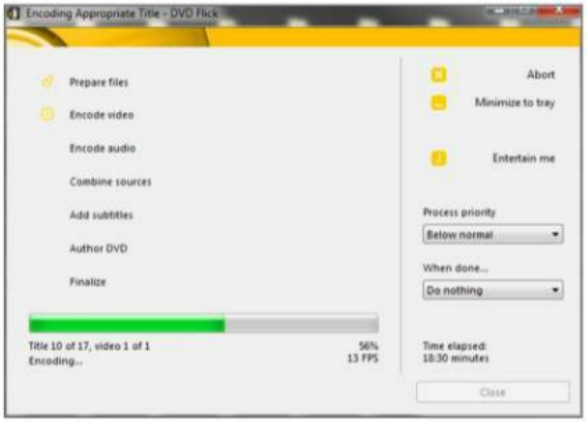
Under Project settings → Playback, you can change the playback behavior of the disc.

CDBurnerXP
Data disc
Allows you to create ISO images, burn usual data discs, MP3-CDs and video discs.
Video DVD
Allows you to create video discs for use with a DVD player.
Audio disc
Allows you to create usual audio discs, with or without gaps between the tracks.
Burn ISO image
Allows you to burn ISO files to disc.
Copy or grab disc
Allows you to copy audio and data discs.
Erase disc
Allows you to remove all contents from a rewritable medium.
Open...
OK
Exit

If DVD Flick can't burn it to disc, you can just use another program such as CDBurnerXP to dump the contents of the Video_TS folder to a disc.

3 CREATE MENUS

By default, the disc you create with DVD Flick should just play on any commercial deck, but Aunt Peg probably wants a menu. Click on the Menu settings button and pick from several pre-canned menus that work fine. Just note that the title menu of the disc will be taken from the Title field of Project settings. To change it to "Kids Video," click on Project settings and General, and change the title to suit your preference.



The time it takes to encode the media is lengthy, so you'll want to do something else for an hour or so during the creation process.

4 BURN IT

Once you're ready, just click "Create DVD" and DVD Flick will begin transcoding the titles and burning the disc. Keep in mind that while we said we'd tell you how to put your videos on a disc in one minute flat, that time doesn't include the encoding and burning. If DVD Flick for some reason can't burn to your DVD player, you can either create an ISO and burn that or use another app such as Ashampoo Burning Studio (www.ashampoo.com), ImgBurn (www.imgburn.com), or CDBurnerXP (www.cdburnerxp.com) to burn the files to a disc. The video files you need to burn are typically located in C:\Users\Your Login\Documents\dvd\dvd. Using CDBurnerXP, for example, you'll want to choose "Video DVD," select the contents of the Video_TS folder, and then burn it.

FINAL ADVICE

The real secret to DVD Flick is its ability to transmogrify (not an actual technical term) just about anything. The program supports 45 file formats, 60 video codecs, and 40 audio formats. From what we've seen, it'll take anything from 3GP to MP4 and convert it without complaining.

One weakness of the program you should be aware of, though, is that it's not for editing video. It's not a full-service video editor nor does it claim to be. If you want to edit out the part of your phone video where you whacked your privates on the hand-rail while trying to perform a skateboard trick, you can't do it. (Although in today's world, skateboarders actually want to edit in the part where privates are smashed on handrails.) And yes, videos that you shot with your phone held vertically (it's officially called Vertical Video Syndrome) will typically be displayed sideways. DVD Flick does try to flip videos correctly when it can, but it isn't consistent. If you want to edit video or add transitions and effects, you'll need a real editor such as Adobe Premiere Elements or CyberLink Power Director. Neither are difficult to learn to use, but aren't apps that you can fire and forget like DVD Flick.

HOW TO...

RIP YOUR DISCS TO STREAM ON YOUR NETWORK

Let's face it: Optical media is a pain in the butt. If you're a real cinephile, you have to set aside a huge chunk of space on your bookshelf for all the Blu-ray discs and DVDs that you've been accumulating thanks to your love of film, TV episodes, and whatever else you happen to enjoy watching.

The raw act of playing a movie can also be a bit annoying. You have to get up off your comfy sofa, chair, or beanbag-type creation; walk over to your movie stash; decide what you want to watch; and slap it in your player of choice. You then have to (likely) suffer through all those stupid advertisements and trailers that Blu-ray player manufacturers will never allow you to skip through. You'll probably have to navigate some creatively designed menu or two just to triple-check that the Blu-ray's audio tracks align with your home setup. And then, finally, you'll get a chance to press play. By then, your popcorn has burned.

It's a lot easier to fire up a desktop or NAS box—or plug a USB key into your DLNA-friendly router—and stream your files around your house instead of fiddling with scratch-prone discs. To do that, you first have to convert your physical media into digital format. And that's what we're here to show you: how to convert your Blu-ray collection into multi-gigabyte files that are a lot easier to manage and view.

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MakeMKV 1.8.10 for Windows
Requires Windows XP, Vista, Win7 or Win8, x86 or x64.
MakeMKV 1.8.10 for Mac OS X
Requires x86 Mac OS X 10.6 or later.
NOTE: MakeMKV is not signed by Apple, you might need to adjust gatekeeper options in order to install the program
Revision history
MakeMKV v1.8.10 (14.4.2014)
Improved handling for discs with mastering errors
Greatly improved conversion speed for multi-segment titles
Small miscellaneous improvements
Bug fixes:
During streaming, program could crash randomly
When changing preferences, program could crash randomly
Fixes for 1.8.9 regressions:
DVD: some titles were missing (incorrectly identified as fakes)
Blu-ray: discs missing JAR directory failed to open
MakeMKV v1.8.9 (27.2.2014)

MakeMKV's website makes it look like it's a dodgy download; trust us, it isn't.

1 OWN THE MOVIE

If only ripping Blu-ray discs were as easy as popping one into your drive, waiting for Windows to fire up a "Rip Disc" Autoplay option, and sitting back while your OS did all the work. Unfortunately, the biggest hurdle between you and digital file-making glory are the digital-rights-management schemes that the movie studios slap onto their discs in an attempt to prevent you from doing everything we're about to tell you how to do.

Everything, that is, with an asterisk: We're not going to tell you how to bypass this encryption directly. We're going to assume that you're simply using this article's knowledge to rip all sorts of other films that aren't locked down by annoying AACS encryption. Should you want to do the not-so-legal thing, you'll just have to figure out that part on your own. The actual ripping process is the same; we just can't tell you how to go about bypassing copy protection. Sorry!

That all said, the first thing you'll want to do is make sure that you have a Blu-ray drive either installed into your PC or attached somehow (yes, USB-friendly external Blu-ray drives exist). You don't need anything super-fancy or super-speedy, since you'll likely set the process to start and go off to make yourself a sandwich (or a three-course meal) while it churns along. Plenty of simple Blu-ray drives can be had inexpensively; don't concern yourself with a writer, or LightScribe support, or any of that—just get a simple Blu-ray/DVD combo drive.

2 DOWNLOAD MAKEMKV

Once you're checked that one off your list, you'll want to hit up your search engine of choice and track down a program called MakeMKV. If you casually do a search for "Blu-ray ripping app" beforehand, you'll find that there are plenty (and we mean plenty) of programs that will allow you to convert the contents of a disc into a digital format. Some will work with AACS-encrypted discs; some won't. Finding a perfect app for Blu-ray ripping is a bit like finding a needle in a haystack, given the proliferation of software that exists.

MakeMKV, we argue, is that app. First off, it's free; that already gives it a pretty strong advantage over most other contenders. Second, it couldn't be much more user-friendly for ripping-newbies. With but a few clicks of some fairly large buttons, your system will be processing that which you've placed into its optical drive without hassle (usually). Third, it works very well with a wide range of discs we've thrown its way.

MakeMKV is free while in beta
Page 1 of 1 [1 post]
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Author
Message
mike admin
Post subject: MakeMKV is free while in beta
Posted: Thu Mar 04, 2010 4:46 am
offline
Joined: Wed Nov 26, 2008 2:26 am
Posts: 3072
As stated on a main page all features of MakeMKV are free while program is in beta. You may purchase the full activation key if you like the program and want to show your support, but you also may use the temporary beta key.
The current beta key is
Code:
and is valid until end of May 2014. Please check back for updated key on this page.
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Page 1 of 1 [1 post]

CCCP
Combined Community Codec Pack
The Combined Community Codec Pack is a simple playback pack for Windows with the goal of supporting the majority of video formats in use today.
Download CCCP 2014-04-20
Download Insurgent 2007-01-01

LEFT MakeMKV's registration key can be found in its online forums. ABOVE CCCP is our favorite, free codec pack for playing all kinds of movies.

Before you start ripping, you need to register MakeMKV—the program will, in fact, prompt you to do so before you can do anything else. If that sounds like a bit of a contradiction, given that we just gushed over the app for being completely free, hear us out. MakeMKV is technically in beta, and has been for some time. The developer continually releases updated registration keys via the official MakeMKV forums, which enable the program's full functionality for a set period of time. Once that time runs out, you have to head back to the MakeMKV website to grab a new key (and often an updated version of the app).

If that sounds like a minor annoyance, you're right. However, it's a very, very small price to pay for MakeMKV's killer functionality. The ability to rip the contents of Blu-ray discs and automatically convert them into full-fledged MKV files, thus preventing you from having to learn about the complicated world of media encoding, fiddle with all sorts of settings, and use more than one app to go from disc to digital file, is pretty amazing.

3 MKV DOESN'T STAND FOR "MAKE KILLER VIDEOS"

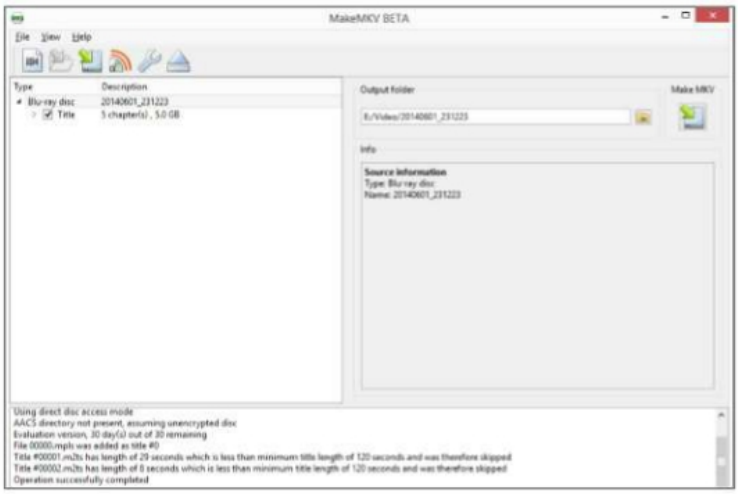
A quick note about these MKV files, though. For the uninitiated, an MKV file is an open-source "container" that can combine multiple audio and video streams (as well as subtitle tracks) into a single, easy-to-modify file. The streams themselves can be encoded in any number of ways; MakeMKV doesn't actually do any encoding itself, which is why the MKV files this app outputs tend to run a bit on the huge side. It just bundles. If you want to shrink your MKV files down to more a manageable size, you'll need to do a bit of post-processing, which we'll cover in a bit.

And, naturally, since MKV is an open file format, a number of third-party developers build support for MKV right into their software players: VLC, MediaPlayer Classic, MPlayer, etc. You'll still likely need a decoder for the apps to play your movies correctly. For that, we recommend the easy-to-install, crap-free Combined Community Codec Pack—give it a Google and a download, and you'll be one step closer to playing the files you have yet to actually rip.

4 START YOUR RIPPING

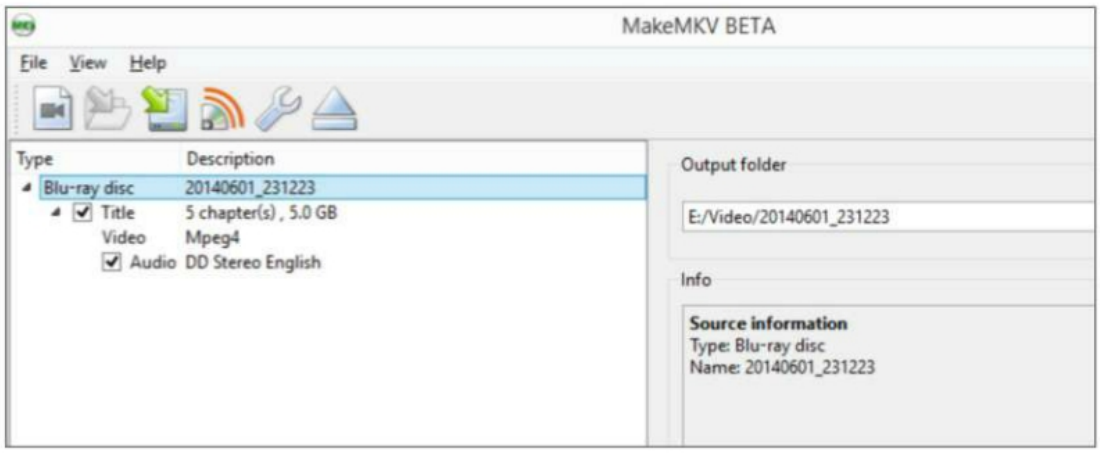
Enough with the wind-up to the main event; let's get ripping. Place your Blu-ray disc into your optical drive and fire up MakeMKV. When you do, the program will immediately perform a quick analysis of the disc and, presuming there aren't any issues upfront, you'll see a giant icon of an optical drive sitting below the Source drop-down menu. If for whatever reason you don't, and your source isn't actually your Blu-ray drive, click that menu and select the correct option.

You'll notice that there aren't really any options you can edit within this screen on MakeMKV. That's intentional. When you're ready to begin the ripping process, click on the giant optical drive icon. MakeMKV will give your disc a thorough scan to ensure that there aren't any abnormalities that could otherwise interfere with the ripping process. It'll also build


MakeMKV BETA
File View Help
Type
Description
Blu-ray disc
20140601_231223
Title
5 chapter(s) , 5.0 GB
Output folder
Make MKV
Info
Source information
Type: Blu-ray disc
Name: 20140601_231223
Using direct disc access mode
AACS directory not present, assuming unencrypted disc
Evaluation version, 30 day(s) out of 30 remaining
File 00000.mpls was added as title #0
Title #00001.m2ts has length of 29 seconds which is less than minimum title length of 120 seconds and was therefore skipped
Title #00002.m2ts has length of 8 seconds which is less than minimum title length of 120 seconds and was therefore skipped
Operation successfully completed

MakeMKV BETA popup
This functionality is shareware. You may evaluate it for 30 days after what you would need to purchase an activation key if you like the functionality. Do you want to start evaluation period now?
Yes
No

LEFT MakeMKV's interface is simple and sweet; click the Make MKV button when you're ready to go. ABOVE You'll get a warning message that MakeMKV is in beta and will only operate for 30 days without a (free) key. The good news is the program has been in beta longer than a Google product.



This home video Blu-ray only has one title, so it's easy to make your choice, but on a disc with multiple titles or videos, just check off the ones that you want to convert.

out the list of titles and chapters on the disc itself, which you'll see in the leftmost portion of the window once the scanning process is complete.

Here's where things get fancy. You can either rip the entire disc as-is, or you can go through and piece together a custom MKV based on the various parts of your Blu-ray that you do (or don't) want to keep. The caveat about that is that MakeMKV can't identify the various segments it's identified on your disc; you might see 15 different titles (corresponding to 15 individual MKV files that the app might make), but only one of these will be your "primary" movie file. The rest will be other media elements that are also on the disc, which you may or may not want to rip as well.

Our recommendation? Don't worry about the individual titles; you can rip the entire disc and delete them later, if you'd like. What's more pressing are the audio and subtitle tracks, as you might not want to, say, rip a Blu-ray disc's full 5.1 track (adding to your file size) if you're just planning to watch the movie on a two-speaker system. Or, for that matter, you might not care about subtitles; no need to increase the file size of your eventual film with features you aren't going to use.

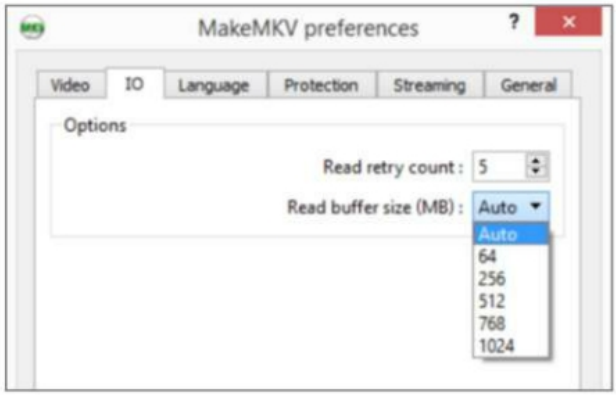
Expand the various titles by clicking on the arrow next to each title's checkbox (which determines whether or not MakeMKV will be making an MKV of that title). You can't change the video (obviously), but you can select which audio tracks you want the app to pack into that title's MKV container. Select and deselect audio tracks to your heart's content; that's the easy part. Subtitles are a bit trickier.

5 LEAVE ON SUBTITLES

You might see subtitles split into two options: A Subtitles option and a second nested Subtitles option beneath it that contains the same language reference as the higher-level subtitle, but with the words "forced only" appended to it. If you'll recall your favorite fantasy movie of choice, you've likely noticed times when non-human people speak languages that you can't actually understand (*Avatar*, anyone?) Forced subtitles are often the words that appear during these parts—different from normal subtitles, in that they'll appear on screen regardless of whether you've turned on a movie's subtitles or not.

We recommend you leave forced subtitles on when ripping your films (for the English subtitles, at least). If you notice that you still aren't seeing the subtitles you should be seeing during parts you can't otherwise understand, you might want to go back and re-rip your movie with the full English subtitles enabled; you can always flip them on and off in your media player of choice.

Once you're ready to rip, click the big icon that looks like an optical drive. Your Blu-ray player will be off to the races—the very slow races, as ripping a full disc's worth of data is going to take a decent amount of time. MakeMKV quoted us around 45 minutes to an hour for our test disc, a 25,799MB source being read at a rate anywhere between 9–12MB/s.



It's best to leave the buffer size on auto; MakeMKV will change buffer sizes depending on how slow the target drive is.

Sit back and relax; it takes MakeMKV a bit of time to rip a packed Blu-ray disc.

OVER 10 BILLION DEVICES
CONNECT WITH USB
USB is everywhere, worldwide. And there's a reason it's so popular—its simplicity, speed and ease-of-use are unmatched. In the world of computers, peripherals and mobile devices, USB inspires confidence as the most widely-accepted, reliable form of connectivity out there, delivering speed, effortless charging and plug and play simplicity. Now that's a technology the world can agree on.
BILLIONS
OF DEVICES
CAN'T BE WRONG.
Check out the latest
SuperSpeed USB 10 Gbps
(USB 3.1) info here:
USB
LOOK FOR PRODUCTS FEATURING THIS LOGO AT YOUR FAVORITE RETAILER.
SUPERSPEED
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USB
Message brought to you by USB Implementers Forum

HOW TO...

CONVERT MOVIES FOR YOUR PHONE OR TABLET

So, you've ripped your movies into MKV files and you're ready to watch them. You could always pull up a chair and hang out on your computer all day long, but you're a busy person. Places to go. People to see. You're not always going to have the luxury of being within arm's reach of your little home cineplex.

Thankfully, devices exist nowadays that allow you to carry and watch your films wherever you happen to be. We're talking about your smartphone (or tablet), of course. Don't forget to bring a set of earbuds or headphones, lest you tick off everyone around you with your home movies.

You can batch-process multiple video files at once in Handbrake; we're sticking with just one, for now.

1 IT'S TOO BIG

There's just one fatal flaw in our mobile movie plan: Those MKV files we previously created are downright huge. Even when we split out everything but the raw movie—no added features, no anything—our test disc provided us a file that was 20GB in size. That's a little too much for your average smartphone. And, even then, you're not going to want to be deleting and transferring new movies to watch all the time.

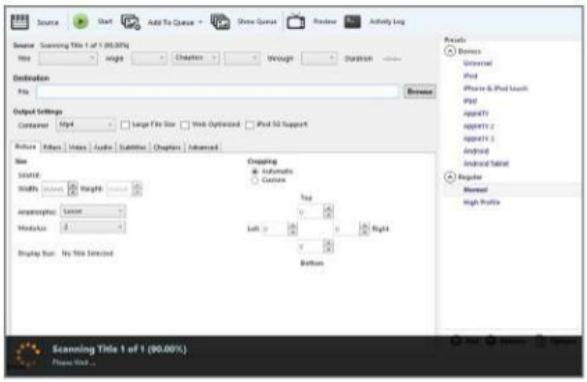
Remember, when we first ripped our test movie as an MKV, we ripped the whole thing: video and audio in its uncompressed, raw form. Compressing your film will allow you to sacrifice a little bit of quality (likely imperceptible to you) for a great deal of space-savings. Plus, you'll be able to shrink the beefier 5.1 audio that you likely ripped alongside your film to a more manageable stereo output—we have yet to see anyone rocking a smartphone in a 5.1 speaker setup, and highly doubt that will ever come to pass.

A word about compression, though: If you really want to squeak out the best combination of file size and quality, you're going to have to fiddle with a number of fairly complex settings. We won't send you down that path if you're just looking for a way to optimize your huge MKVs for Android or iOS sans hassle, but know that there are plenty of additional options you can play around with if you really want to—it's all a matter of personal preference and just how much space, and what kind of quality, you're looking for.

2 USE 720P TO SAVE SPACE

One thing we'll recommend right off the bat: Go 720p. While it's true that a number of today's smartphones have 1080p-resolution screens, and your picture might look a smidge more pixilated than if you were running it at your screen's native resolution, we found that we couldn't notice a difference when playing a 720p and 1080p movie on our HTC One smartphone. We'll gladly take the space savings: 49MB for 11 minutes of the 720p film versus 87MB for 1080p—a 44 percent decrease.

The app that we'll be using to do our conversation is a tried-and-tested bit of freeware: Handbrake (www.handbrake.fr). It costs you nothing to download or use, and it combines basic functionality—in the form of presets that you can pick from, for the casual converter, with advanced options for those who want to experiment with what the app can do to their movies.



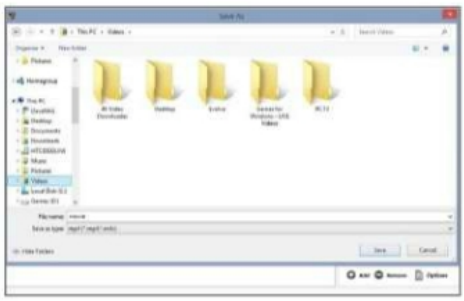
Handbrake initially scans your file so it can figure out your default options—handy!

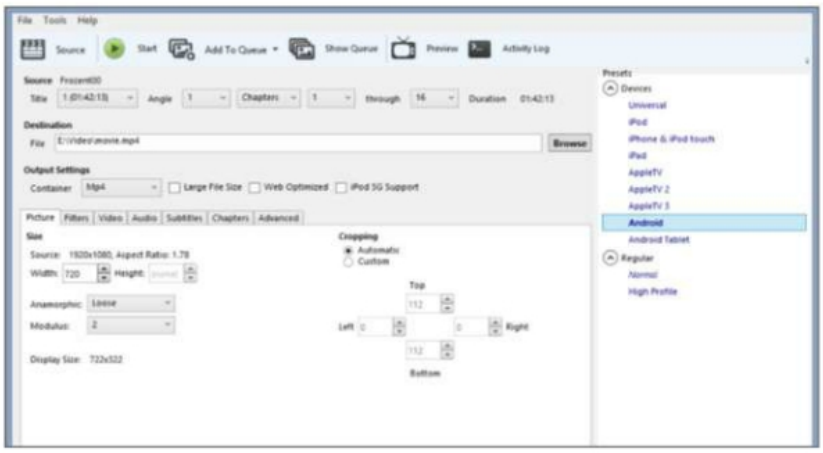
3 DON'T GET OVERWHELMED

Once you've downloaded and installed the app, fire it up and try not to feel overwhelmed by the number of options that you can play around with. For our basic conversion task, you won't have to fiddle with much.

Start by clicking on the Source button, selecting "Open File," and browsing over to wherever you stashed your MKV file(s) on your system. Select the one you want to convert and hit "Open." Pick whichever device on Handbrake's sidebar matches what you'll be watching your movies on—iPhone or Android, for example. This will automatically modify a number of settings within Handbrake, including the size the video itself that the program will output. In the case of Android, this defaulted to a 720p video automatically when we were using a 1080p video as our source file.

While you could just slap the big green start button and call it a day right now, there are a few other settings worth exploring when converting your movie for mobile use. If you want to bump up the quality of your film, go to the Video tab and look for the slider for the preselected "Constant Qual-





ABOVE Before you start editing video options, pick a destination folder (and name) for your movie. RIGHT The right-hand presets are pretty useful for those who want to encode movies sans fuss.

ity" setting. The more you move the slider to the right (lower numbers), the higher the overall quality of your video—and the greater the file size. Go left, and you'll reduce the file size at the expense of quality.

Why does this matter? We're normally fine sticking with Handbrake's presets quality-wise (especially given the size of the screen we'll be watching the film on), but it might be worthwhile for you to know if the file size of your film is still especially large after Handbrake converts it on the app's default settings. If you don't mind a bit of quality loss—or test various iterations of the Constant Quality setting and find that you can't really see much of a difference at all—it might be worth your while (and your ability to pack tons of movies onto your device) to reduce the movie's overall quality and tighten up its file size.

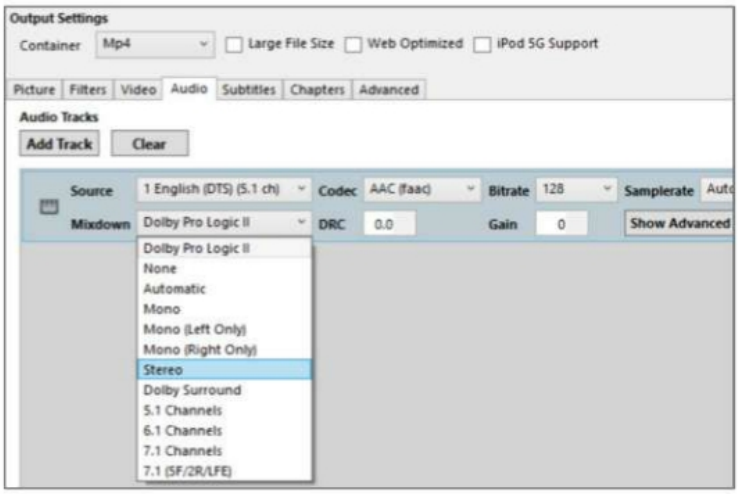
Otherwise, you'll want to do a little more tweaking in Handbrake's Audio tab. In there, go to the drop-down menu for the movie's audio Mixdown and change it from whatever it happens to be to Stereo. Since your smartphone isn't a 5.1 device, you don't really benefit from (nor do you need) the extra audio tracks, and that should help your movie's file size a bit. If you want to play with quality settings in this screen, the Bitrate option is where you'll be able to dial down the audio track's quality in order to shrink the final file size of your film.

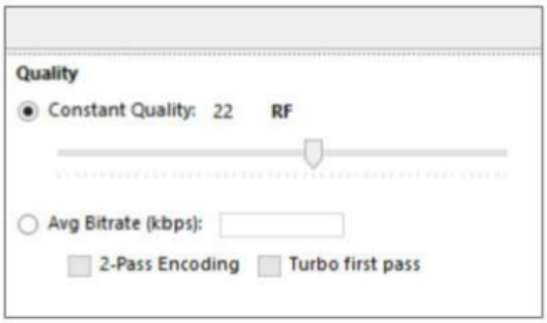
4 START YOUR TRANSCODING

Ready? Ready! Click the green Start button at the top of Handbrake's window to start the transcoding process, which transforms your MKV file into a more universally accepted MP4. While your video churns along, hit up the Google Play or Apple App Stores and look for two particular apps for playing your final films. We're big fans of VLC—especially for iOS—but it's currently in beta on the Android platform, so your mileage may vary as to just how well the app works on your particular hardware.

If you're finding that VLC is giving you a bit of a headache on Android, try switching over to MX Player. It's one of the more popular Android apps for video viewing, but it doesn't support any videos encoded with DTS audio. We already fixed that by converting our MKV file to stereo, but in case you passed up our advice, that might be the reason why you're possibly seeing video and hearing nothing when you go to watch a ripped movie on your smartphone.

By now (plus an hour or so, depending on your system's speed and the size of the MKV you're converting), your video should be just about done. If not, and Handbrake is reporting that the total estimated time for converting is going to be some hideous amount, you can always go to Tools → Options. Once in the General section of Handbrake's preferences, look for the option that allows you to set what the app should do "When Done." Change that to Shutdown, and your system will power off as soon as Handbrake is done converting your movie—a useful option for when the app has to run all night long.





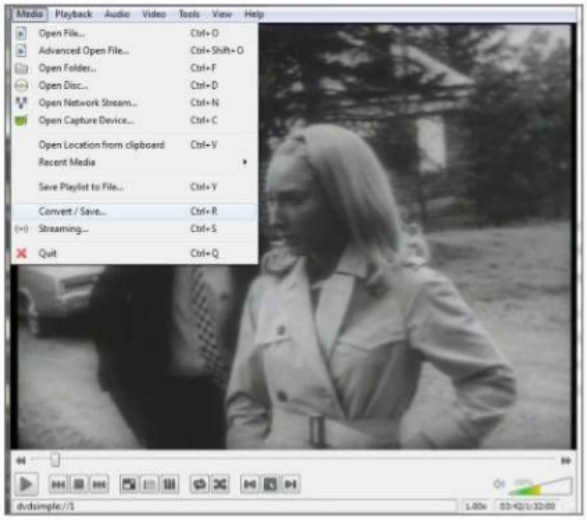
LEFT Ditch that 5.1 surround sound if you're only going to watch movies on a stereo device. ABOVE The "Constant Quality" setting is where you trade file size for performance improvements.

HOW TO...

MAKE YOUR OWN AUDIO BOOKS

The average American spends almost 2.5 hours a day in the car—that's not counting those poor souls trapped in grid-locked cities on a 95-degree day. One way to keep your mind from turning to mush is interesting audio choices. In today's world, though, that's not easy, what with FM radio being a wasteland of pop music that drops your IQ by the second, and the AM band a wasteland of kooks and cranks screaming about the PC being king (kidding). Once you've burned through the free offerings on Librivox.org, you'll need a new source of entertaining audio as you mash the gas and brake pedals for the next 27 miles.

For some of us, that's making your own audio books. Well, we loosely call it an "audio book," but it's really taking the audio track from your favorite movie or television show to listen to during your commute.



Is there anything VLC won't do?

1 VLC TO THE RESCUE

Ideally, car makers would use disc players (yes, people still use those) that could play just the audio track of a DVD in their default audio systems, but the best you can do in most cars today is play an MP3 file from a disc. So how do you listen to Star Wars IV on the way back from your 9-to-5?

The cheapest (but not quite the easiest-to-work-with) piece of software that'll solve this dilemma is that Swiss Army knife of media tools: VLC Media Player. The basics are fairly easy but not as straightforward or full-featured as a commercial app. We've also found it to be little flaky on extraction at times, too, but it's hard to argue with the price tag of "free." Download VLC from www.videolan.org and install it, then insert your disc in your optical drive and fire up the program.

2 SET YOUR QUALITY LEVEL

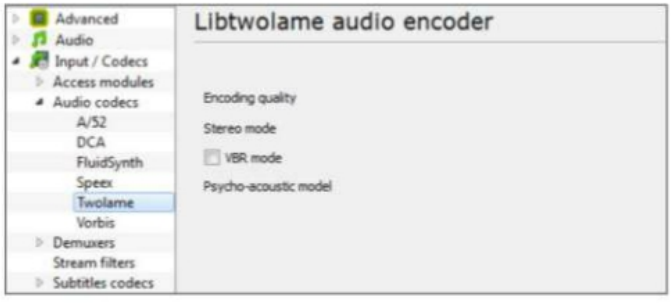
If you intend to rip multiple discs, you can set your quality preferences by hitting Ctrl + p and clicking the "All" radio button under "Show Settings" on the left-hand side. Drill down and look for "Input /Codecs" and select Twolame under Audio codecs. This lets you set your default audio encoding quality. Click save. Now hit Ctrl + d or click "Media / Open Disc," and confirm that the DVD radio button is selected. You'll also need to tell VLC which title to select. Typically, this is Title 1; you can also watch the movie using VLC to try to determine what the Title number is. If you're trying to grab a secondary audio track, you'll also need to play with the disc to determine which audio track you want as well. We've found that the -1 input on Audio track seems to work for most movies.

3 SELECT CONVERT

On the bottom of the "Open Media Dialog" window, click the triangle and select convert. Then, under destination, click the Browse button, and give the file a proper name. Be aware, if you don't browse to the location where you want VLC to put the file, it won't convert the file. Now, under Profile, select "Audio - MP3." Click Start and VLC will begin ripping the audio track. When you're done, you should have a meaty little MP3 file that can be moved onto your audio playback device of choice.

4 GETS THE JOB DONE

For the most part, VLC will do the job for most folks, but if you're really serious about producing your own audio discs, we actually recommend investing in a commercial product. We've had great luck with ImTOO DVD Audio; it lets you rip the audio track into small 10MB chunks that can then be burned onto a CD in chapters (make sure you burn the disc as a gapless disc) and can perform normalization of audio across the disc. ImTOO DVD Audio will set you back $29, though, and it doesn't handle encrypted discs.



ABOVE You can set the encoding quality and stereo mode for all encodes. This does get reset if you install an update, though. BELOW Make sure you select the Destination file location and name, or it won't work.

HOW TO...

ARCHIVE YOUR CD COLLECTION PROPERLY

What's that? You actually have physical discs for your music? You haven't yet subscribed to the digital age of downloading all of your jams in a friendly MP3 or AAC format, for use on almost any device you can get your hands on? You still use your car's CD player?

We don't mean to be (too) glib; there are people who still purchase physical discs for their music (us among them), especially when bands pack all sorts of extras and lovely design work in a deluxe, physical package. However, that doesn't mean that you should just hold onto your discs forever. Ripping them to your computer ensures that you'll always have a copy of their contents should the unthinkable happen: your precious, impossible-to-repurchase disc gets a scratch, you accidentally break it, or the disc just becomes unreadable for a variety of random, annoying reasons like disc rot.

You can pull down information for your disc from the Web, and edit anything that appears off.

1 LET'S TALK FORMATS

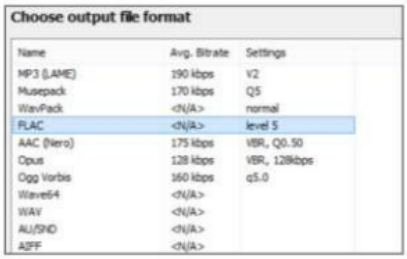
Thankfully, converting your musical tracks to digital files is one of the easiest things you can possibly do on your PC. If you've ever used a handy little program called iTunes, the software practically does all the heavy lifting for you. If it's set up correctly, you just have to fire up iTunes, pop in your CD, wait a few minutes, and you'll be able to enjoy the fruits of your (minimal) labors via your iTunes library. However, we think you can do better.

First off, let's talk formats. MP3 is pretty much the standard for digital music tracks at this point, but it's a lossy format. While it might sound indistinguishable from a CD track to your ears, it's not a picture-perfect digital representation of the original source audio. For that, you have to turn to a lossless codec like Apple Lossless or FLAC—the latter is an open-source codec that does a slightly better job with compression at the expense of encoding speed.

One secondary advantage of a lossless codec: You can copy and convert that file to a lossy codec sans issue. If you start lossy, like ripping all your files as super high-quality MP3s, then reconvert these files to another lossy codec at some point down the road (lower-quality MP3s that you want to fill your smartphone with), that's definitely going to affect the audio quality.

2 DOWNLOAD FLAC

If you're not an Apple / iTunes fan, we recommend you grab the all-encompassing app Foobar2000 (www.foobar2000.org) for ripping and converting your CD into FLAC files. When you go to install it, make sure you're performing a Full installation, which will also install the various converter utilities the app uses during the ripping process. Also grab the FLAC Windows binaries from Sourceforge, (http://sourceforge.net/projects/flac/files/flac-win) and install them, too.



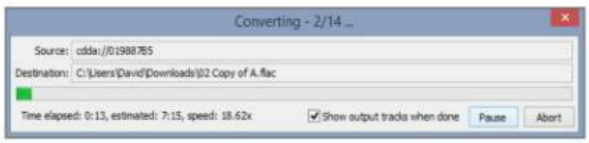
Make sure you pick FLAC as your output format (and have FLAC preinstalled!).

3 MAKE PERFECT ARCHIVES

Open up Foobar2000 and go to File → Open Audio CD, select your correct optical drive from the presented list, and then click Rip. We like to then click the Lookup button to ensure that Foobar2000 has correctly matched all the information it can glean from the MusicBrainz or freedb online databases to your disc (you can select either to use). After that, click the "Proceed to the Converter Setup dialog" button.

The Converter Setup window is simple. For the output format, select FLAC. In the Destination options, you can customize the file names of what Foobar2000 will be creating; we like adding "%track%" to the beginning of the file names so that we can keep a CD's contents in its correct order. Otherwise, those are the major options you have to consider; we didn't add any processing effects, as we want our files to be faithful digital recreations of the original CD audio. Click the Convert button, select a destination for the files, point to the location where the FLAC executable was installed (likely in your Program Files x86/Flac directory), and wait!

If you want to jam what you've previously ripped, you can play your FLAC files directly from Foobar2000, as well. For an app that's a bit more comprehensive music library–wise, check out MediaMonkey (www.mediamonkey.com).



You can pull down information for your disc from the Web, and edit anything that appears off.

HOW TO...

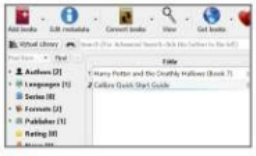
PUT YOUR E-BOOKS ON ANY DEVICE

So, you've been on a spending binge, buying e-books from wherever you like, whenever you like, as well as healthily partaking of the offerings at Project Gutenberg (www.gutenberg.org). You've been using various apps to read all of your willy-nilly acquisitions, but now you'd like to consolidate everything into one tidy, centralized location. One where you can then push out your books in any format to most common e-readers and tablets. Heck, maybe you'd even like to get fancy and store your e-books in the cloud or set up a content server so you're never without the written word. Enter Calibre and its plugin feature to the rescue.

1 INSTALL AND SET UP CALIBRE

There are other software programs that can do parts of what Calibre does—and some even do a few select things better, like offering prettier virtual bookshelves—but we much prefer just how comprehensive this program is. You can read, manage, format, sort, and convert all the books in your library, and even manage the books on your e-reader or tablet as well.

To get started with Calibre, first download it from http://calibre-ebook.com/download_windows and install it. Next, Google for Apprentice Alf's plugin for Calibre and download it from AA's WordPress site. Be sure to uncheck the box that asks you to use the download manager, and also be careful to only click on the gray "Download" button to avoid installing unwanted things. Then unzip the file and install the plugin via Calibre's Preferences menu.



This is what Calibre first looks like when you fire it up, but there's one more step to do before adding all your books—installing Apprentice Alf's plugin.

2 BUILD YOUR CENTRALIZED LIBRARY

Close and restart Calibre, then make sure you've installed the Kindle application to download e-books bought from Amazon (.azw/.mobi formats) or Adobe Digital Editions for just about everywhere else (.acsm format).

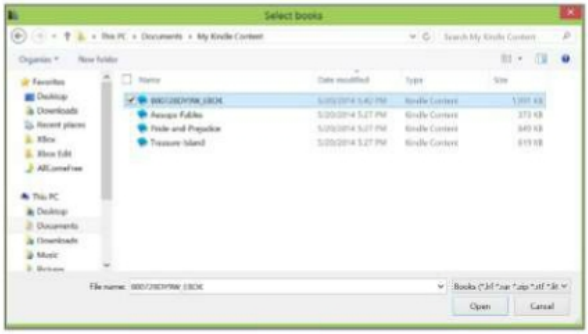
To import your e-books, click on the "Add Books" button on the menu, then navigate to the folder where each program keeps its library. (For Kindle, the default is "\Documents\My Kindle Content"; for Adobe Digital Editions, "\Documents\My Digital Editions.") You can add whole directories at a time, or just individual files. Unless you're running Calibre on a netbook (which we're pretty sure you're not), the importing should go very quickly for each book.

3 CONVERT TO YOUR PREFERRED FORMAT

Now here's the fun part: converting your e-books to the format you want them in. Select which books you want to process, then click on the "Convert Books" button, which will automatically bring up the "Bulk Convert" dialog box. (If you prefer to tweak each individual book's settings before conversion—like tags, series information, and cover image—click instead on the drop-down arrow next to the Convert Books button and select "Convert Individually." You can edit these settings after conversion, too.)

Once everything's set, click "OK," and Calibre will take care of its task in a jiffy.

ABOVE In the Plugin menu, choose "Load Plugin from File" to get started with the plugin-installation process.
BELOW Grab as many files as you like at one time, or just dump the whole directory into Calibre all at once.



4 TAKE IT FURTHER

So, what's next? Well, you can use Calibre to load your fresh, now-compatible files onto your e-reader or tablet—the software will usually recognize which device you're using as soon as you plug it in, and ask you if you'd like to allow it to manage it. If you choose yes (and we recommend you do), it's easy work to see which e-books you've loaded for travel and which ones you've yet to.

You can also use cloud storage as your library location to both backup your collection (for those paranoid about losing all their books to a hard-drive crash) and access your books from multiple computers. If you want to take it even further, you can also experiment with using Calibre's ability to operate as a content server. Time to get fancy!

REVIEW

ROKU STREAMING STICK

Now that you've liberated all of your media, what to do with it? Sure, you could load it onto a NAS box or home server, but that requires more work—it would be really nice if you could just buy a device for the time being so you could toss up videos and music from your smartphone or tablet to your big-screen TV as you wanted.

One contender for being such a solution is the Roku Streaming Stick, the company's most compact addition to their lineup of cable-box replacements—but does it actually work well in that capacity?

NOT QUITE

Among its other touted features (namely, being able to choose from over 1,000 "channels" and 31,000 movies for entertainment), the Roku allows you to view photos, listen to music, and watch videos that you have stored locally on your device. The only problem? It can't handle large videos without a fair amount of buffering, nor those not formatted as .mkv, .mp4, .mov, or .wmv using the H.264 codec. So if you've spent your time ripping all of your Blu-rays as .avi files, or you've got anything larger than a hundred MB, you're out of luck.

HOWEVER...

If you want an *expansion* of all the media you have on hand, though, the Roku Streaming Stick works great for that—and even offers some competition for the Chromecast (reviewed in the November 2013 issue). Like Chromecast, you can cast Netflix and YouTube to your TV, but you have access to more than just a handful of integrated services (remember those 1,000+ channels?). And unlike Chromecast, which requires you to install separate apps for each service you use, Roku's channels are all accessible directly through its interface (which you can navigate with the included remote).

The caveat, though, is that many of its channels require purchase, a paid subscription, or a cable subscription to take advantage of them. The freebies, while a nifty perk, offer rather scant viewing selections; generally, we got the most out of watching news clips and PBS.

We also weren't fans of having to sign up for an account at Roku.com in order to add channels—particularly because we also had to add a credit card to even complete setup of the unit. Sure, it might be "convenient" to buy content under this system, but we resent being strong-armed into participating in a walled ecosystem.

SO, WHICH TO GET?

Certainly, the Roku isn't the only streaming stick around. But it occupies a different space than the Chromecast—the latter is more geared toward folks who like to do everything from their tablet or laptop. And video streaming from non-YouTube sites is now quite smooth (a far cry from Chromecast's early days), meaning if most of what you want to view is on the web, saving $15 and buying Google's product is a better bet.

If you're the sort to want more of a TV/cable experience, though, the Roku Streaming Stick will make you happier. While you can use a smartphone or tablet to control the stick via the Roku app, the included remote means you'll never have to dig around (or charge) a second device in order to zone out in front of the boob tube. With the addition of easy setup (even if it includes that dratted required account signup), it's a worthwhile addition to your living room for media junkies. It just won't play all the stuff you've ripped. –ALAINA YEE

VERDICT **8**

Roku Streaming Stick

GINGER BEER Easy set up; easy streaming of music from a tablet or smartphone; lots of channels to peruse.

GINGER SUPPLEMENTS Have to create an account and add a credit card to it in order to complete setup; large personal videos often buffer several times while viewing.

$50, www.roku.com

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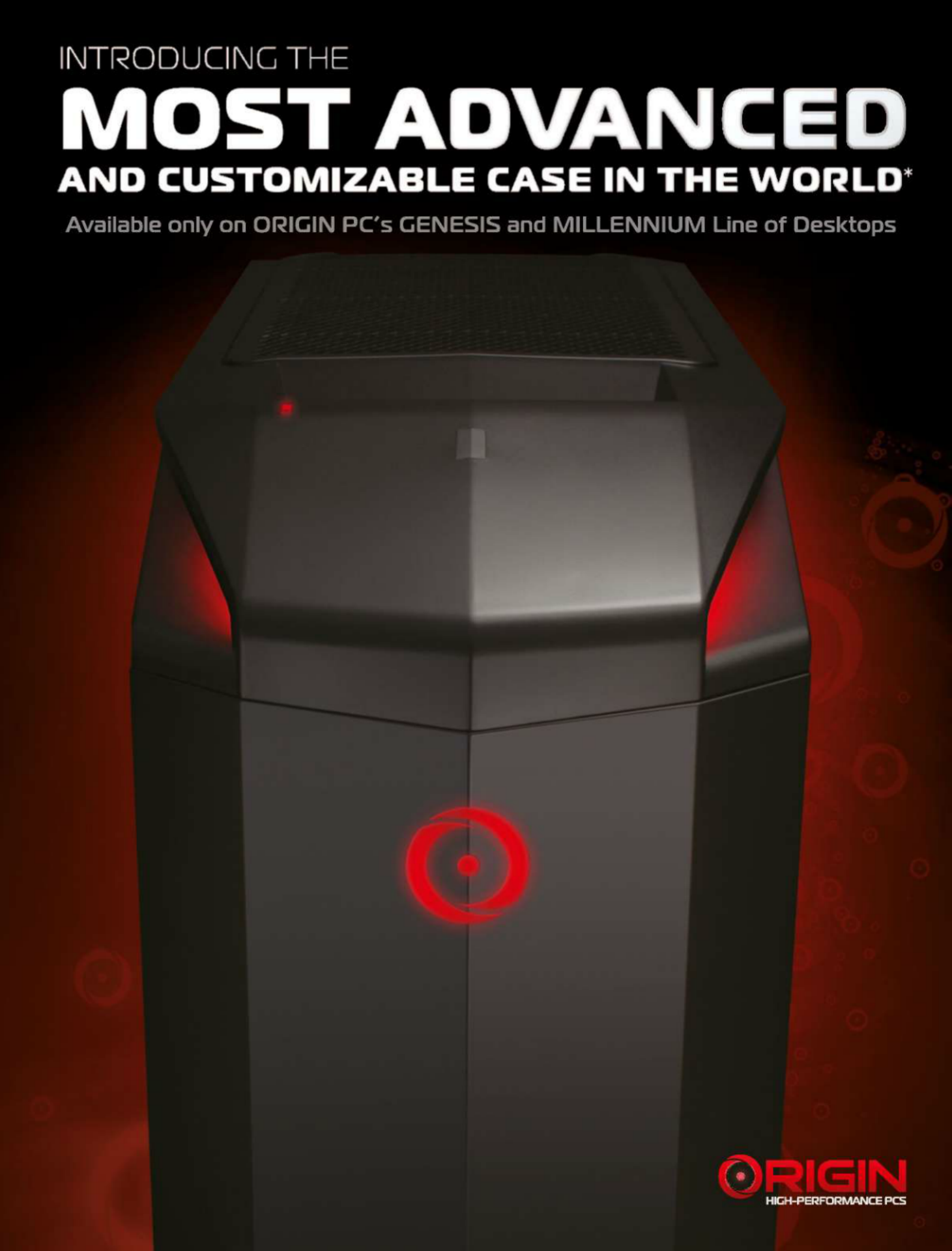

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SATA3 SATA-EXPRESS

Z97 COMES ASHORE

A new crop of mobos promises next-generation storage

BY GORDON MAH UNG

We can still remember the hand-wringing motherboard makers had before Z87 launched, bemoaning the two to three years of dead space between chipset launches, during which time they would have nothing to tickle consumers' fancies with. Well, guess what? They were wrong. Here we are, less than a year after Z87 launched, seeing its replacement: Z97.

Besides next-gen I/O options, Z97 motherboards are the only ones guaranteed to work with Intel's upcoming CPUs. So in the spirit of spending, we've rounded up four solid midrange motherboard contenders to see which is worthy of going into your shiny new PC.

Z97 Is Here, but Is It Right for You?

That's actually a rhetorical question, because the answer is yes

FIRST UP, LET'S TEMPER your expectations. Oftentimes upon hearing the phrase "next generation," people get giddy and their thoughts jump to rocket jet packs, self-cooking chicken pot pies, or a new Enterprise with three warp nacelles. Z97 ain't that. Nope. Not by a long shot. In fact, Z97 is so similar to the Z87 that launched just 11 months before it that it even shares the same code name: Lynx Point. So if you're expecting 50 lanes of PCIe 4.0, USB 3.1, and maybe a free Haswell thrown in for kicks, you're not getting that with Z97.

In fact, what you know of Z87 you already know of Z97: It supports Intel LGA1150 CPUs, dual-channel RAM, and has six native SATA 6Gb/s ports. In the actual new column is support for the M.2 storage spec and SATA Express. Both move flash-based memory to their own interfaces rather than being saddled down with those plebeian mechanical hard drives. Both SATA Express and M.2 increase the theoretical bandwidth to about 1,000MB/s. That's a healthy step up from SATA's 600MB/s, and more importantly, it allows flash-based storage to step up the pace. Developed primarily as a hard-drive interface, SATA just doesn't move fast enough for flash or next-generation memory, so the two will part ways, which is a good thing.

For the most part, the rest of the changes in Z97 are pretty inconsequential, although features such as using a PCIe-based device to cache a hard drive is new. We can see you yawning already, but know this: The Z97 is the only choice today for someone building an LGA1150 system who cares about future upgrades. That's because Z97 boards will officially support Intel's upcoming Devil's Canyon chip and the socketed Broadwell K CPU due early next year. While there's a chance most of today's quality Z87 boards will support the Devil's Canyon CPU (although not guaranteed) the 14nm Broadwell K CPU required power changes at the board level.

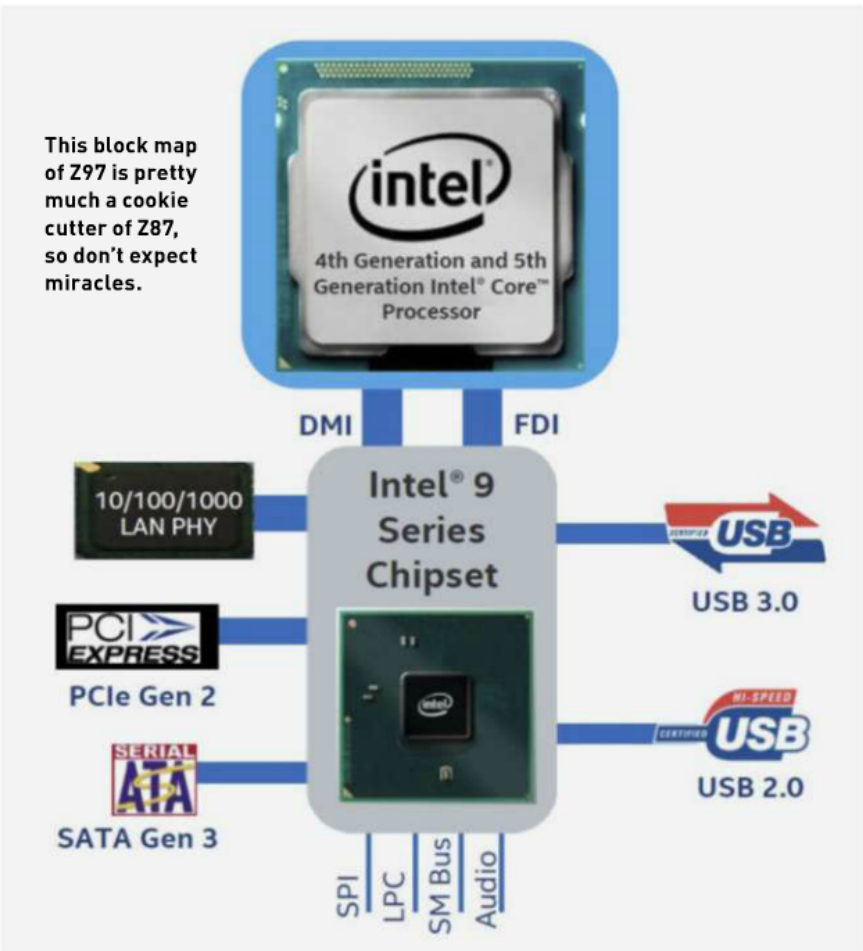
So, while you think Intel may be pulling another clock-blocking trick by preventing you from inserting Broadwell into your shiny three-month-old Z87 board, company officials have sworn on a stack of technical manuals that it is truly a technology limitation, not a marketing decision.

What that means is anyone considering building a new PC with the chances of adding any of the upcoming CPUs should opt for Z97.

Besides that, for most consumers, the main appeal of Z97 will be in the next-generation storage interfaces, although of the two, M.2 is already a known quantity and has been tacked into existing boards. We reviewed M.2 SSDs months ago, and have already seen devices with M.2 ports, so, meh. SATA Express, however, is the one everyone has their eye on to see if it brings any improvements.

What we can say now is that we don't know. During our review, we were unable to obtain any actual SATA Express storage devices. Asus did include its conceptual Hyper Express drive, which combines two ADATA MSATA drives in RAID 0 with a SATA Express port on the end. The end result is something that should offer SATA Express speeds. Unfortunately, we couldn't get the Hyper Express to work with the competing motherboards that have SATA Express ports. That makes it difficult to gauge the value of SATA Express at the moment.

Still, that doesn't mean we think you should shrug your shoulders at Z97. At this point, there's simply no reason to build on Z87 unless you got a rocking deal on the board. We don't think you should rush out to "upgrade" your perfectly functional Z87 board to Z97 board, either.



This block map of Z97 is pretty much a cookie cutter of Z87, so don't expect miracles.

ASUS MAXIMUS VII HERO

A Republic of Gamers mobo without the big bill

IN ASUS'S LINEUP, the Republic of Gamer faction carries the lineage of premium motherboard. And for the most part, Asus doesn't disappoint with the ROG: Maximus VII Hero. The company has been on a roll with its exceptionally polished and smooth UEFI, which has left competitors scrambling to catch up. Though others have stepped up their game, Asus's UEFI is still the clear leader.

Asus leadership extends into its massive suite of applets and tools too, with such well-thought-out features as Direct to BIOS, FanXpert among the large amount of utilities included. All of these get a polish and improvement, and there's no features such as KeyBot that let you add macro functionality to a generic keyboard in hardware. The idea is that you don't need to buy a $100 plank—just buy this mobo instead.

Our only problem though, is the complexity Asus's offering has today. There's simply so many switches, modes, and flip-out doodads that you can easily become overwhelmed. On the hardware front, Asus configured the Hero with three sets of x16 slots. The board itself supports only SLI or CrossFireX across two of the slots. The MSI and Gigabyte reviewed below let you run three-way CrossFireX. On the storage front, there are six SATA 6Gb/s slots using the Intel PCH, plus another SATA 6Gb/s pair using an Asmedia controller. Asus, interestingly, has chosen to give you an M.2 but no SATA Express. Why? The company feels implementing both on a board is a compromise. Because the Z97 chipset has so few PCIe lanes in the southbridge, you can't run M.2 and SATA Express simultaneously. Even as configured, the Hero cuts off the stubbier PCIe slots when M.2 is enabled.

The Hero also trailed slightly behind the three other boards here. All of our testing is done at stock speeds with default UEFI settings and we use the same components in all of the boards, as well as double-checking component configurations, so it's a head-scratcher as to why the ROG lagged a bit. We honestly think it's likely the result of Asus not pushing the CPU as hard as its competitors—which is odd, as it's usually the one over the line.

That makes our verdict split. While the board has ladled on goodness such as Sonic Radar II (basically an audio cheater mode), separated audio paths, and a massive amount of options, the slight performance delta and rough edges on some of the software suite had us torn. We really like this board, especially as it's almost affordable at $230 (for a ROG board, anyway), but those few rough edges can't help but mar the overall score.

VERDICT

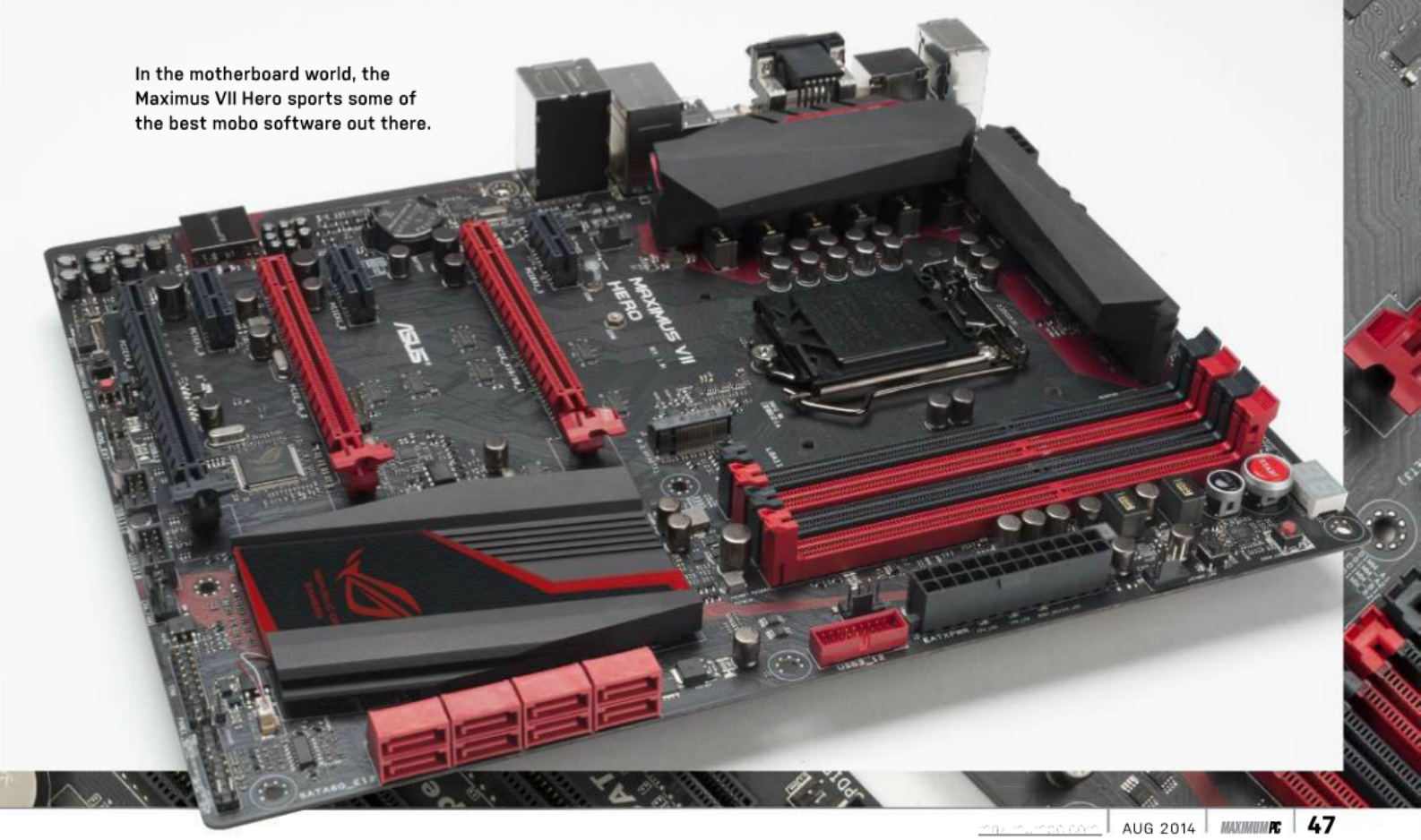
8

Asus Republic of Gamers Maximus VII Hero

$230, www.asus.com

SPECIFICATIONS

USB Ports/Headers	4x USB 3.0, 2x USB 2.0 / 2x USB 2.0, 1x USB 3.0
Expansion Slots	3x x16 physical, 3x x1 PCIe
Storage	8x SATA 6Gb/s, 1x M.2 (PCIe mode only)
Fan Headers	6
Ethernet	2x port using Intel I-218V Gigabit controller
Multi-GPU	Two-way CrossFireX, SLI



In the motherboard world, the Maximus VII Hero sports some of the best mobo software out there.

GIGABYTE GA-Z97X-UD5H

It's what's inside that counts

GIGABYTE'S GA-Z97X-UDH5H doesn't have the flashy heatsinks nor gamer red color scheme, but it's an eminently serviceable, fast motherboard that offers pretty much the best balance of features of the mobos here.

In the important column for storage fetishists, the UD5H offers both an M.2 and SATA Express port. We tested the M.2 performance of the UD5H with the Plextor M6e SSD that we reviewed in the June 2014 issue slotted into the M.2, and it was spot on. We also tried testing SATA Express using the Asus experimental HyperExpress drive but had no luck. In other words, the jury is still out on SATA Express, but at least M.2 gets it done.

In amenities, the board gets a retro feel with Gigabyte's decision to offer two PCI slots. One we can see, but *two* PCI slots in the year 2014? Hello, 2008. There are still three x16 physical slots—two of which can be run in SLI or even three-way CrossFireX mode. Anyone who plans to pack this board full of hardware and exotic storage options should be aware that what ports are hot and what slots are on will depend very much on what is occupied. Because Z97 is so poor on PCIe lanes, motherboard makers have had to resort to robbing from Steve to pay Bill. For example, plugging in an M.2 will shut off SATA Ports 4 and 5. It's not just the UD5H, either. The Hero halves the PCIe bandwidth to the bottom slot when an M.2 is installed.

Gigabyte has made great strides forward with its bundled apps, too. They're easier on the eye, fairly straightforward, and full-featured. That's saying a lot, as just two generations ago, the company's apps looked like they were stolen from Radio Shack. Gigabyte also continued to buff its UEFI interface, which is better but has a bit of a Jekyll-Hyde-and-Larry mode. There's a new simplified interface, a second performance-tweak interface, and finally, a throwback "classic" mode, too.

Performance of the board was quite good. The UD5H was dead even with the MSI entry and definitely ahead of both Asus boards. That's a surprise result, as Asus usually has the edge in performance on new launches by pushing the CPUs clocks slightly higher than its competitors.

Perhaps the icing on the cake, besides getting to choose either SATA Express or M.2, is that the board is also $40 cheaper than the ROG.

VERDICT 9

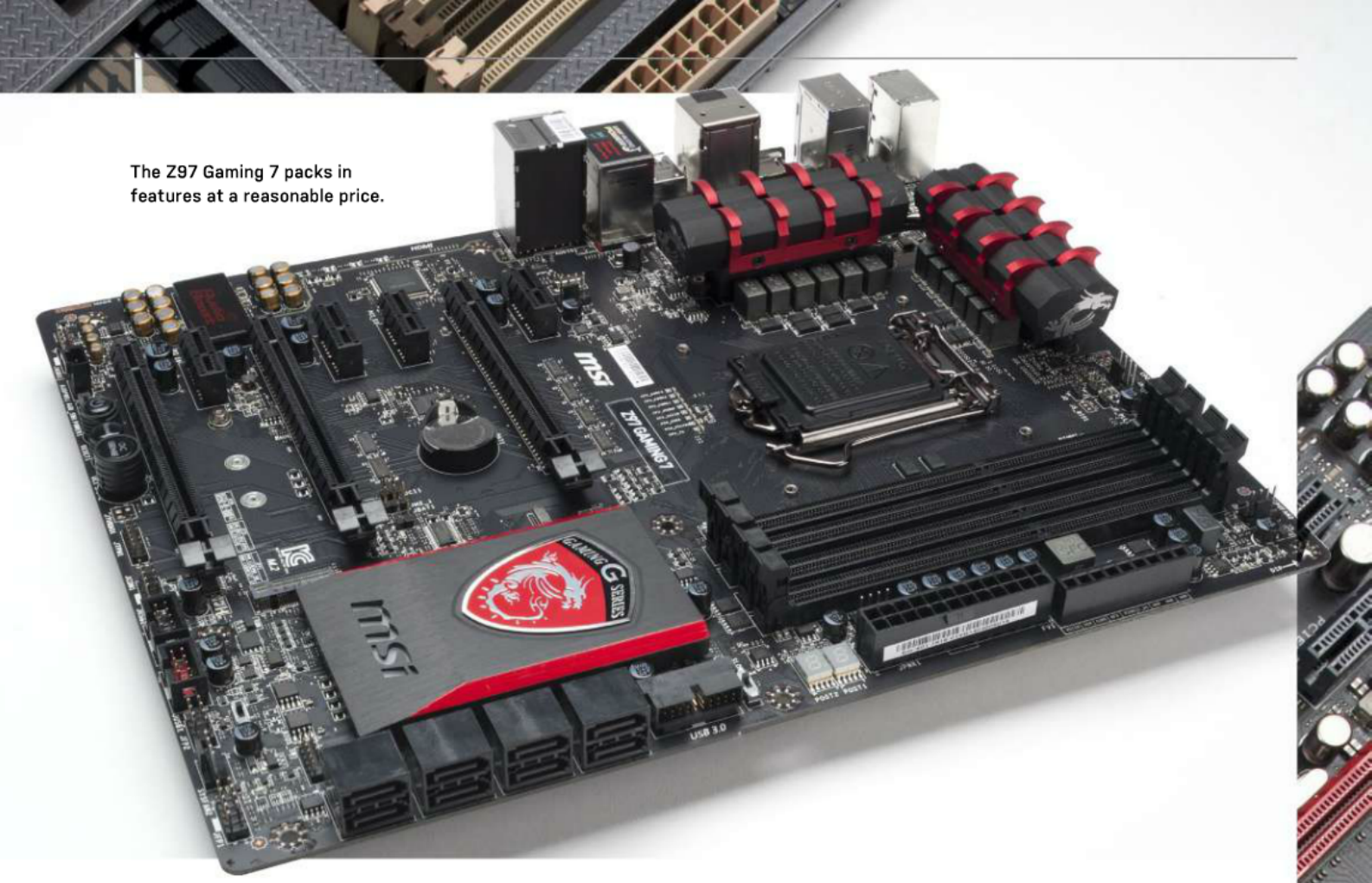
Gigabyte Z97X-UD5H

$190, www.gigabyte.com

SPECIFICATIONS

USB Ports/Headers	6x USB 3.0, 2x USB 2.0 / 1x USB 3.0, 2x USB 2.0
Expansion Slots	3x x16 physical PCIe, 1x x1 PCIe, 2x PCI
Storage	8x SATA 6Gb/s, 1x SATA Express, 1x M.2
Fan Headers	6
Ethernet	1x KillerNIC E2200 Gigabit, 1x Intel Gigabit
Multi-GPU	Up to three-way CrossFireX, SLI

The GA-Z97X-UD5H is probably the best-balanced board of the bunch.



The Z97 Gaming 7 packs in features at a reasonable price.

MSI Z97 GAMING 7

Red means gaming

PSST. Want to know a secret of the motherboard industry? It's all about the colors. Consumers have become so confused by the array of motherboards that makers have had to sort them by color to help consumers un-kink their minds.

MSI, frankly, has the color thing sorted out. Yellow is for extreme overclockers, blue is for normal computers, and red, well, red is for gaming.

Like the Gigabyte UD5H, for a mid-range motherboard, it offers a nice balance of features that will appeal to overclockers and gamers. There's rails to directly read voltage off the motherboard, a nifty POST LED that kicks over to indicate CPU temps once the system is posted, and well, if Gigabyte and Asus have separated ground planes to increase audio fidelity—so does MSI. MSI even one-ups them by adding an audio power circuit that lets you run power straight from your PSU to the motherboard's audio. In theory, this eliminates noise that would otherwise have to pass through the planes of the motherboard.

MSI has also stepped up its app and UEFI game, too. It's not in the class of Asus, but it works well enough. It's not quite as centralized as Gigabyte's or Asus's, but it's skinned for modern times.

In storage, MSI skips SATA Express and includes an M.2 slot. The slot supports both SATA and PCIe and when in use, you'll lose two of your SATA ports so RTFM if you're having problems getting drives to come up when using an M.2.

The MSI board did well in performance. It was on par with the Gigabyte UD5H, with both just edging the Asus offerings in several categories. For motherboard reviews, we prefer to judge new boards by how well they auto-overclock, as most newbs are going to reach for the auto button first. In that respect, the Gaming 7 was rather meh. The only option to overclock is for a user to power off and click the OC Genie button. The automatic-overclock OC Genie gave us was a full-time 4GHz. Yeah, that's technically an overclock but it's pretty conservative for a 4770K part, which typically turbos up to 3.9GHz. We will say that at least the speed step worked.

Overall, we think the Gaming 7 is a nicely presented, nicely outfitted board for a mid-range offering. Frankly, even if the Gigabyte has more flexibility than the Gaming 7 with its M.2 and SATA Express, we know that when buyers are in the store and presented with the plainer-looking UD5H and the red-and-black Gaming 7—both at the same price—most will actually opt for the red-and-black.

VERDICT

9

MSI Z97 Gaming 7

$190, www.msicomputer.com

SPECIFICATIONS

USB Ports/Headers	8x USB 3.0, 2x USB 2.0 / 1x USB 3.0, 2x USB 2.0
Expansion Slots	3x physical x16, 3x x1 PCIe
Storage	8x SATA 6Gb/s, 1x M.2
Fan Headers	5
Ethernet	1x KillerNIC E2200 Gigabit
Multi-GPU	Up to three-way CrossFireX, SLI

ASUS SABERTOOTH Z97 MK I

A tough, conservative mobo that's not for everyone

WHAT'S MORE IMPORTANT with a motherboard: 10K Titanium capacitors, alloy chokes with a special beveled top to increase surface area, or military-grade MOSFETS and five-year warranty?

None of the above. It's all about how it looks. Let's be shallow and admit that we like blinking lights and LED readouts, or in the case of the Sabertooth Z97 Mk I, a cool-ass stealthy blacked-out armor that covers the front and the back. The best part of the Sabertooth Z97 Mk I is that it actually gives you all the fancy features we listed earlier plus the "armored" look we're actually quite fond of. It's even functional. When running liquid cooling, there are sliding vents and fans that let you actively cool just the power circuits on the motherboard.

Initially, we thought Asus's pitch on the Mk I was just marketing fluff, but it's apparently not. The board isn't intended just to appear as a tough mobo to run in harsher climates, it actually walks the walk, too. For example, of the four boards here, it's the only one to follow Intel's guidelines on maximum clocks on the Core i7-4770K under a multi-threaded load. The Mk 1 keeps the cores at 3.7GHz, while the other three boards boost the cores up to 3.9GHz. Asus says it does this because that's what Intel's spec calls for, following it to the letter. Basically, the board is truly aimed at a different crowd. Not pure gamers, not pure overclockers, but reliability-and-durability, umm, enthusiasts.

In performance, that leaves the Mk 1 a little slower than the others on CPU-sensitive apps. The board features a SATA Express port that we were actually able to test with Asus's simulated SATA Express device. It's basically two ADATA mSATA SSDs in RAID 0 in a shell with a SATA Express port. In performance, we were hoping to see it eclipse what we've seen out of M.2, but it didn't. The best we got out of it was a 653MB/s sequential read and 350MB/s write. The M.2 Plextor M6e saw sequential reads of 744MB/s and writes of 580MB/s so, well, yawn. Again, we'll have to wait for authentic SATA Express devices before we render our final judgment on it.

You should also know that while there are nice touches such as additional thermal probes and slot covers and the most fan headers in this roundup, there are no surface-mounted controls, no post LED, and it doesn't even auto-overclock worth a damn, so you're giving up a lot of features for the "tough" features of the board. If you're into it, more power to you, but most probably would rather save the $70 and go with the Gigabyte or MSI board. Still, we're going to admit up front that we actually really liked this board despite the meh verdict we gave it. It's just that most people are probably best served by one of the three other boards here.

VERDICT **7**

Asus Sabertooth Z97 Mk 1

$250, www.asus.com

SPECIFICATIONS

USB Ports/Headers	4x USB 2.0, 4x USB 3.0 / 2x USB 2.0, 2x USB 3.0
Expansion Slots	3x physical x16, 3x x1 PCIe
Storage	8x SATA 6Gb/s, 1x SATA Express
Fan Headers	7
Ethernet	1x port using Intel I-218V Gigabit controller, 1x port using Realtek 8111GR Gigabit controller
Multi-GPU	Up to two-way CrossFireX, SLI

The Sabertooth comes with a pair of fans to push air through the "armor" when used with liquid cooling.

Benchmarks

Balance and performance trump colors

PERFORMANCE ON MODERN MOTHERBOARDS has become a fairly boring category. With so much functionality packed into the actual CPU cores, we typically don't see much of a difference. That's not always true though, as a badly optimized UEFI or a mistake in design can hit performance, so we still run the boards through tests to see if they're up to snuff. We install the same CPU, same SSD, and same GPU, as well the same drivers, with clean OS installs in each of the reviewed boards. We also go through and carefully check each subsystem to make sure each component is configured the same.

Our benchmarks are also selected to be more about system-level testing, such as memory bandwidth and SSD performance, and more general-use, such as PC Mark 8. We also try to coax any differences out of the boards by testing them with a few games run at lower resolutions and Valve's older Particle physics test.

In this roundup, though the margin was fairly small, we would give the nod in performance to the Gigabyte and MSI Z97 boards. There's clearly a pattern, though small, of the boards being "faster." What makes them faster? It's generally how aggressive the mobo maker is at pushing the CPU. Since the chips are unlocked, the board makers can decide to simply ignore Intel's guidelines and clocks, and run the chips harder than recommended. Does it hurt anyone? Not really. Intel's guidelines are pretty conservative and these parts have a lot of headroom, so we think a stock "overclock" is kosher. This puts the Gigabyte and MSI boards ahead at "stock" speeds. The Sabertooth Z97 Mk 1's conservative nature, however, saw its lower turbo clocks put it behind the others by a larger margin. If that's a turn-off, you could simply open up the UEFI and increase the multiplier a few notches. You certainly can't do it automatically. We tried the board's wizard-based auto-overclock and it failed miserably to obtain any overclock at all. We're not sure why the feature is even there. The MSI's auto-overclock is also pretty miserable. This really leaves the Gigabyte Z97X UD5H as the overall top contender by a notch. Despite the lovely utilities packed onto the Hero that should be lauded, the GA-Z97X-UD5H is the winner here.

BENCHMARKS

	Asus Maximus VII Hero	Gigabyte Z97X-UD5H	MSI Z97 Gaming 7	Asus Sabertooth Z97 Mk 1
Sisoft Sandra (GB/s)	20.8	21.6	21.6	21.5
3DMark Firestrike	8,549	8,634	8,636	8,498
3DMark Graphics	9,651	9,680	9,683	9,659
3DMark Physics	10,360	**11,057**	**11,040**	9,840
PCMark 8 Home	4,008	**4,194**	**4,231**	4,088
PCMark 8 Creative	4,486	4,439	4,501	4,486
PCMark 8 Work	3,376	3,456	3,485	3,384
Valve Particle (fps)	195	211	205	205
Resident Evil 6 low-res (fps)	21,271	**22,738**	**22,322**	21,016
Hitman Absolution low quality (fps)	70.4	80.7	**82.2**	77
Hitman Absolution high quality (fps)	57.1	**66.2**	65	61.8
SATA 6 Performance Crystal Disk Mark R/W (MB/s)	525 /498	507 / 481	**537 / 517**	**531 / 504**
Auto-Overclock Level	4.4GHz	4.6GHz	4GHz	Fail

Best scores are bolded. We used a Core i7-4770K, 8GB of Kingston Fury DDR3/1866, GeForce GTX 780, Thermaltake Water 2.0 cooler, 240GB Corsair Neutron GTX, Windows 8.1 Enterprise in all of the configurations. SATA 6Gb/s performance was obtained using a 512GB Samsung 840 Pro on an additional SATA 6Gb/s port.

THE DIRECT X EVOLUTION

THEY SAID IT WAS DEAD. THEY SAID IT WOULD NEVER RETURN. THEY WERE WRONG. DIRECTX 12 IS COMING, AND NVIDIA THINKS IT COULD BE SOMETHING RATHER SPECIAL

BY DAVE JAMES AND MARCO CHIAPETTA

Microsoft's all-encompassing, Windows-based graphics API has come under serious attack over the last few years. Since DirectX 11 was released in 2009, very little has changed for the MS API, yet OpenGL has seen huge improvements and swelling industry support. We've also seen AMD go back to the drawing board and use its position inside the Xbox One to push for a new API specifically for its own graphics card architecture.

With Valve urging game developers and hardware manufacturers to put their support behind Linux/SteamOS and its use of the OpenGL API, and AMD claiming huge performance gains from its Mantle API, many people were predicting the end of DirectX. With a lack of statements to the contrary from Microsoft, it was thought DirectX 11.2 may have been the final splutter of a dying software abstraction.

How foolish those doomweavers sound now. Just before the Games Developer Conference this March, a Twitter account popped up with the @DirectX12 handle, teasing: "Rumors of our demise have been greatly exaggerated... #DirectX12 is coming to GDC." The tweet linked through to an official-looking webpage, with a big DirectX 12 image above both Xbox and Windows logos.

Sure enough, GDC came and, like a geeky version of Live Aid, folk from Microsoft, AMD, Intel and Nvidia got together on stage to talk about how the new iteration of DirectX was going to save mankind and its love for PC gaming, by creating a software union of Xbox console and your gaming rig.

Just after GDC, we sat down with Nvidia's Ashu Rege, VP of game content and technology, and his right-hand man, Yury Uralsky, to find out where the new version of DirectX came from, how it's been put together and what it means for the future of PC gaming. These guys provide the link between games developers and the hardware Nvidia has engineered, and are in a unique position to comment on what it looks like from both sides of the relationship.

"IT WAS THOUGHT DIRECTX 11.2 MIGHT HAVE BEEN THE FINAL SPLUTTER OF A DYING SOFTWARE ABSTRACTION"

Currently an Xbox One exclusive, *Forza 5* is the only DX12 title around.

So, what is DirectX in the first place? Essentially, it's a conglomeration of different application programming interfaces (APIs) aimed at dealing with all kinds of multimedia fun in Microsoft operating systems. When we're talking about DirectX in relation to gaming, what we're generally referring to are the specific versions of Direct3D. That's the part of the package that includes hardware acceleration, enabling us to throw 3D objects around a 3D environment while using the best bits of our 3D graphics cards. 3D!

DirectX was first introduced with the birth of Windows 95 to provide a platform for game developers to create rich multimedia content for the new operating system at a time when most of them were dyed-in-the-wool MS-DOS programmers. In the beginning it was a bit of a rush job, trying to encourage developers to start programming for the new OS rather than DOS. Unfortunately, DirectX often introduced more performance overheads than DOS, which itself allowed devs to get total access to the specific hardware.

The battle between providing a solution that works across the broadest range of hardware and reducing the resulting overheads has been part of DirectX's DNA from its inception.

"The reason there's a lot of interest in low-level APIs is partly historical," explains Ashu Rege. "Back in the day, when people were programming hardware, you were accessing it directly."

DirectX isn't the only graphics API. OpenGL was there first, and later on we also had Glide—another proprietary API specifically designed for the 3dfx Voodoo Graphics 3D cards. But the exclusive nature of Glide, the broadening scope of DirectX and OpenGL, plus some terrible business decisions meant it didn't last long past its '90s heyday, and most of its best assets now belong to Nvidia. We also have Mantle, another proprietary API specifically designed for the AMD Graphics Core Next 3D cards. One can only speculate what's going to happen to that, but we hope for AMD's sake it doesn't ape Glide too closely.

"Graphics APIs have been evolving for years," says Ashu. "The main ideas are the same, though. You want to provide some abstraction to allow you to get to the hardware without having to worry about the hardware changing." This is the key to creating an all-encompassing API such as DirectX and its Direct3D component. You need to make sure that when a game is coded using the tools for an API, it's still compatible when new hardware rolls around. But the API itself will continue to evolve as well, introducing new features, and so you also need to ensure that the API can be extended to offer developers continued access to the new options.

This is why we've reached a stage where the Direct3D API is so far abstracted from the actual hardware it supports—it's trying to cover a very broad spectrum of both hardware and software features. "As the hardware got more complex, the API started getting further away from the hardware because you had the ability to support many different vendors and many more features that you wanted to expose," explains Ashu.

ABSTRACT THOUGHTS

One of the targets for DirectX 12 is to cut down on that high level of abstraction. "Now we've gotten a little too far away from the hardware," Ashu says, "and we are going back to accessing the hardware more efficiently and at the lower level without losing all the good features of the API. The goal is to reduce the overhead—which is the single biggest thing—where the driver often adds extra overhead and CPU cycles are used up in the driver rather than in the application. It's also to give developers more control, especially for engine guys, like Epic, Crytek, or whoever; there's more access."

DirectX 12 @DirectX12 · Mar 21
Gamer version of the Oscar selfie with #DirectX12 at #GDC. aka.ms/directx12 pic.twitter.com/fvGvWNxUDk
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This is something Microsoft itself was at pains to point out when it announced that the new API was on its way. "It provides a lower level of hardware abstraction than ever before," wrote Matt Sandy on the DirectX Developer Blog, "allowing games to significantly improve multi-thread scaling and CPU utilization. In addition, games will benefit from reduced GPU overhead via features such as descriptor tables and concise pipeline state objects."

This lower level of hardware abstraction is the current buzzphrase around graphics APIs. It's the way game developers have been working with the fixed-platform consoles for years, and has allowed them to squeeze unprecedented

levels of performance out of the aging last-gen games boxes—just take a look at what Rockstar managed to pull out of the Xbox 360's pocket-calculator hardware with the vast *Grand Theft Auto V*. Developers have tighter control of how their code works on the console hardware, whereas DirectX has put more and more layers between the devs and the PC. In short, DirectX has become bloated and all that fat is making our lightning-fast hardware wheezy and slow.

"You don't want things sitting between you and the hardware, taking away precious CPU cycles and wasting performance," Raja Koduri, corporate vice president of visual computing at AMD, told me at CES in January. "How do we get rid of the API overhead so we can get many, many more objects, many, many more draw calls, to take games to the next level?"

CORE VALUES

AMD's solution to this problem is Mantle. The company has been trying to achieve this low level of software abstraction with its proprietary API for its Graphics Core Next hardware, and now it's the key goal for DirectX 12. Though it's going to be a lot tougher trying to implement a closer tie to the varied cross-vendor hardware that Direct3D has to support.

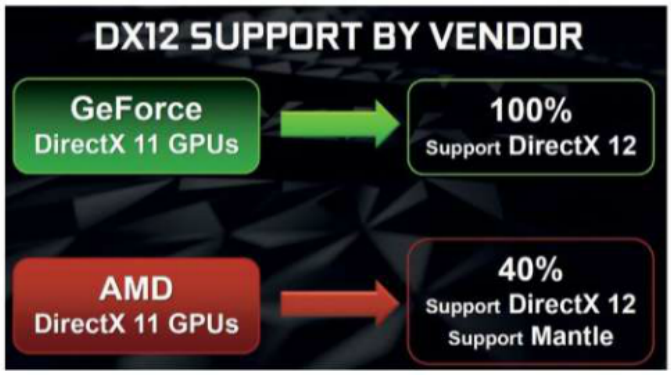
The key to achieving all of this is improved efficiency. Bringing the API closer to the metal makes for more efficient use of the hardware available. "Overhead comes from a bunch of API calls and you have a certain amount of CPU cycle time that goes into translating those API calls into a hardware abstraction," explains Ashu.

"The focus this time around is on reducing CPU overhead as much as possible and improving API efficiency in general," adds Yury Yuralsky. The improvements can be characterized as radical. There are very significant gains in runtime efficiency and driver efficiency."

It's become a familiar refrain with recent API talk: The CPU is holding us all back. The current version of Direct3D introduces a ton of CPU overhead, mostly because GPU technology has improved more rapidly than processor tech.

"The GPU has outstripped the CPU," explains Ashu, "both in terms of floating-point computation and in terms of bandwidth. That creates an unbalanced situation where the CPU can become the bottleneck because it cannot feed the GPU fast enough."

"YOU DON'T WANT THINGS SITTING BETWEEN YOU AND THE HARDWARE"



Another part of the problem is a lack of proper multi-core scaling within the DirectX API. Just sorting out single-core CPU efficiency isn't enough to bring Direct3D kicking and screaming into our multi-core present. "Older APIs—like DirectX 9—were pretty poor at the utilization of multiple cores. Back when DX9 was designed, most people had single-core CPUs," says Ashu. Deferred context support was introduced with DirectX 11 to push multi-core CPU performance, but it didn't quite go far enough.

"The goal of deferred context support [in DirectX 11] was to simplify the transition of existing code paths, which were primarily single-core oriented, onto multi-core," continues Yury. "So, efficiency

THREE PILLARS OF PERFORMANCE

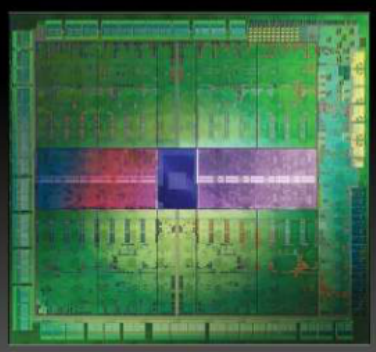
Microsoft has picked three key areas in which the new DirectX 12 API differs significantly from those that have gone before it. The first of these is pipeline state objects; the second is command lists and bundles; and the third is descriptor heaps and tables. That's serious developer talk there, but we'll attempt to simplify things a bit.

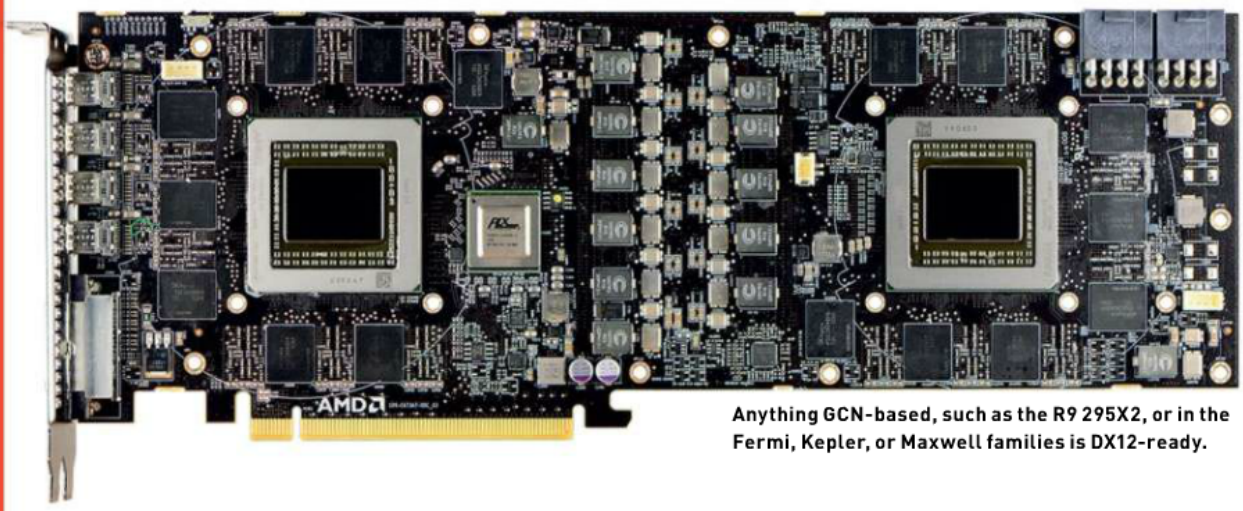
DirectX 12's pipeline state objects (PSOs) take the flexibility of the DX11 pipeline, where different states can be changed individually at any time, and simplifies it. In DX11, this complete flexibility means the driver is unable to resolve different elements until they have been finalized at draw time, which consequently adds extra overhead and reduces the number of draw calls per frame.

DX12 unifies a lot of the pipeline states (pixel shader state, rasterizer state, and so on) into PSOs. These objects are finalized when they're created, which reduces the overhead and maximizes draw calls, but are still mutable, with less of an impact at draw time.

The command lists of DirectX 12 essentially make it easier for different CPU threads to assign work concurrently to the GPU. In D3D11, all the operations are submitted in a long stream of commands in a serial manner for the GPU to execute one after another. D3D12's command lists contain all the relevant information, such as what texture is needed and what PSO to use, and so are completely self-contained. They can therefore be assigned to the GPU in a thread-free manner.

The third of these pillars is the descriptor heap. Direct3D 11 had become inefficient in the way it handled resources. This made it very convenient to use, with a high level of abstraction from the hardware, but it also meant a lot of hardware capabilities went under-used. When a game engine wanted to use different resources, it had to go through similar processes from scratch. Direct3D 12 uses descriptor heaps and tables to store different resource usage in easily accessible areas. This makes it more efficient to reuse resources in different ways without redrawing everything.





Anything GCN-based, such as the R9 295X2, or in the Fermi, Kepler, or Maxwell families is DX12-ready.

was not the topmost priority. This is being completely fixed with DirectX 12. With the DX12 deferred-context API, it's now focused specifically on performance."

So, just like Mantle before it, DirectX 12 is focusing on trying to make more efficient use of all the component parts of our PCs' hardware. Being able to spread the workload on the CPU across all of its available cores means it can keep up with the demands of the GPU and ensure there is no bottleneck forming between the two. Microsoft has demonstrated the gains it expects to get using an early implementation of DirectX 12 running on 3DMark.

"3DMark on Direct3D 11 uses multi-threading extensively," wrote Matt Sandy on the DirectX Developer Blog. "However, due to a combination of runtime and driver overhead, there is significant idle time on each core. After porting the benchmark to use Direct3D 12, we see two major improvements—a 50 percent improvement in CPU utilization, and better distribution of work among threads."

DX12 HARDWARE IS HERE

This is great news for games coded with the DirectX 12 API. It should mean that modern game engines use the full power of our hardware, but there's still the problem of encouraging devs to make the move to a brand-new API. Again, though, Microsoft has been thinking long and hard. We're sure the wounds from the botched introduction of DirectX 10 and its restriction to the Vista OS millstone are felt throughout Redmond, and it must be keen to avoid such problems in future.

One of the best ways to garner developer support is to make sure there is a large installed user base ready to go for DirectX 12 games, and thanks to support for existing graphics hardware, there will be. All of Nvidia's current DirectX 11 GPUs—that's Fermi-, Kepler-, and Maxwell-based cards—will be compatible with DirectX 12. On the AMD side, only the Graphics Core Next cards will be able to support the new Microsoft API (some 40 per cent of its DX11 cards). The vast majority of us won't need a new graphics card to take advantage of all the platform-efficiency improvements promised for the new API.

WHAT'S AMD DOING WITH MANTLE?

One of the strangest things about the DirectX 12 announcement was the question of why AMD spent so much time and money putting together a proprietary API that is likely to have an incredibly short shelf life. With Nvidia claiming that it's been working with Microsoft on DX12 for four years, you'd have to assume that AMD had also been there from the get-go.

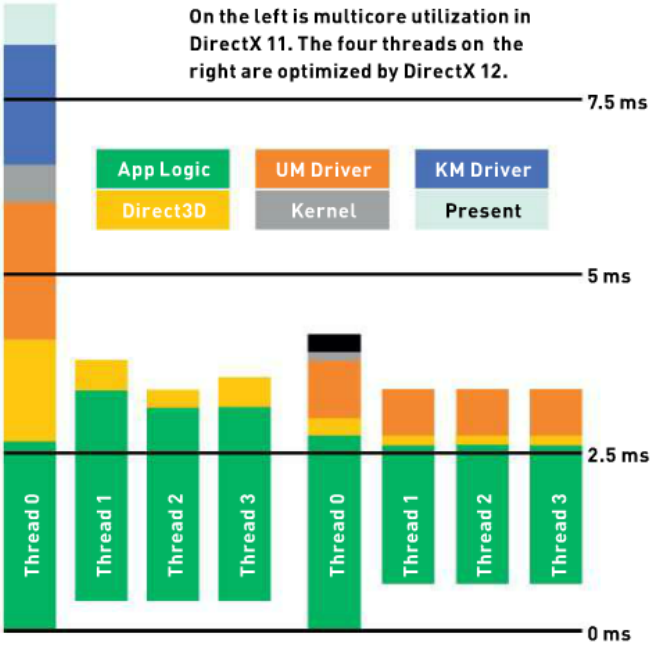
It's quite possible that DirectX 12 wasn't always the ultra-efficient low-level API it's now being touted as. AMD's decision to go it alone with Mantle, and the performance gains that it has demonstrated by using a software layer that's closer to the metal, could well have convinced Microsoft that this was the way to go with a new iteration of DirectX. That seemed to be what AMD's Neal Robison was intimating at CES in January. "Will this make Microsoft make more changes and enhance DirectX? I don't know," he said. "I hope so. You could look at working together with Microsoft to make enhancements to DirectX."

AMD's Raja Koduri admitted in January that such low-level API enhancements were vital to PC gaming. "Mantle, or Mantle-like technologies, are definitely necessary. You've seen the amount of overhead there is in the current PC APIs—it's just eating up a whole bunch of CPU cycles for no good reason."

It wouldn't be the first time a hardware manufacturer created something off its own back, for its own hardware, that Microsoft subsequently dropped into DirectX. In fact, Intel's own DX11.1 extension, PixelSync, which was introduced at GDC last year, is being directly ported into DirectX 12 to support order-independent transparency, helping make smoke and other transparent materials more realistic. AMD's efforts to make its next generation of GPUs work well with a low-level graphics API can only mean good things for them when it comes to moving over to DirectX 12. All is definitely not lost.

How much of a role has Mantle played in encouraging Microsoft to go back to the drawing board with the next version of DirectX?

Are the API wars over? With *Star Citizen* supporting Mantle, DirectX, and OpenGL, we're not so sure.



That's great news, and ought to help adoption of DX12 development.

Another factor that will help enormously is the involvement of consoles in this venture. Microsoft has announced that DirectX 12 won't just be a PC API—it will also be the graphics API that powers its phones, tablets, and the Xbox One console. We're not just talking about using a similar software layer, either.

"Fundamentally, the API is the same," explains Yury. "Microsoft explicitly stated [that] DirectX 12 is going to be the API for the console as well as the PC and other Windows platforms. The reason it's cool from a developer's perspective is that they can target a huge install base while coding to an API, which is also ported to console."

"This was not the case when DirectX 11 was launched, because all the consoles were basically DX9-class, so you essentially had a bifurcated development process," says Ashu. "This is a pretty big deal because if you talk to game developers you just have to ask them a simple question: 'How many actual console devkits do you have in your studio, and how many of your people are regularly programming in them?' Usually, that number is in single digits. The actual amount of time they spend coding is mostly on the PC. Having this transferability now makes their lives easier, because the PC can be treated as a bigger, better version of the console and you just have to scale it down."

And, like the hardware, the DirectX 12 software is already in the hands of the developers. At GDC, the Xbox One exclusive *Forza 5* was shown running directly on PC hardware using DirectX 12. It took developer Turn 10 just two or three months to shift the code from the current Direct3D 11.x renderer on the Xbox One to the new PC Direct3D 12 API. "Microsoft has a group [who are] the top developers in the world," says Ashu. "We've given all of them our driver, and a lot of them are already working on DirectX 12 stuff. All the key guys have DX12 access as well as our driver and our hardware." Microsoft is anticipating that we'll start to see DirectX 12 games hitting the stores in the autumn of next year, which means those games have to be in development right now.

Compatible hardware is already available and the software is already in the hands of the games developers. If DX12 will run on DirectX 11 hardware, is there any reason why it wouldn't work on DirectX 11–compatible software? "We'll defer to Microsoft on this one," says Ashu sheepishly. "Is there any technological reason? There are challenges, there's no question, but I think it's quite doable."

So, will we see DirectX 12 running on Windows 7 PCs? What are the chances of Microsoft limiting DirectX 12 gaming access to gamers only using newer versions of Windows? "Everybody's aware of that situation," says Ashu. "The truth is Microsoft went through it themselves, they went through it with Vista and DirectX 10. I think the right way to think is to be optimistic because you hope that we've all learned from the past."

This was the first we knew of the links between Xbox and PC via DirectX 12. But which OS will get the new API?

And what of AMD's Mantle API? With only a year until DirectX 12 is unleashed in gaming form, and with development of compatible titles going ahead right now, from an Nvidia point of view, it must seem that the writing is on the wall for AMD's proprietary software layer.

"I personally think that the API wars are over," says Ashu. "There's DirectX and there's OpenGL. They're well-established; a lot of companies have invested a lot of capital and man-hours to bring them to their current level. Now, it's just a question of are you on Windows PC or Xbox one? Then you've got DirectX. If you're on Linux, SteamOS, or Android—or iOS for that matter—you're on OpenGL. We support both equally."

A History of DirectX

THE MOST SIGNIFICANT VERSIONS OF MICROSOFT'S GRAPHICS API

Back in the early days of PC gaming, MS-DOS was the de facto platform for virtually all prominent game developers. Some games were developed for the first versions of Windows, but since they ran on top of MS-DOS—and working under DOS gave developers low-level access to hardware—game devs fully embraced the primitive, GUI-less OS.

In the lead-up to Windows 95's release, though, Microsoft knew it had to do something drastic to woo developers into making games for its fledgling OS, and that's when DirectX was born. DirectX is the name given to a handful of application programming interfaces (APIs) for creating game and multimedia content. It eventually made its way into Windows 95 OSR2 and has been updated numerous times since. Here's a list of some of the more impactful versions of DirectX, along with a few details on what make them significant.

DIRECTX 1.0

Microsoft's Windows Games SDK was released in September of 1995, in what could technically be called DirectX 1.0. This version was not widely adopted by game developers due to its newness and fear that Microsoft wouldn't be able to make Windows a viable gaming platform, but we mention it here because it was the first version, and because it laid the foundation for all future releases. It also turned Windows into a relatively high-performing multimedia platform, though there was a marked performance penalty when using DirectX/Windows, versus native DOS-based solutions.

The original DirectX logo resembled some sort of hazardous warning sign.

3D accelerators in the DirectX 5.0 era—precursors to modern GPUs—relied on AGP, or Accelerated Graphics Ports, for connectivity.

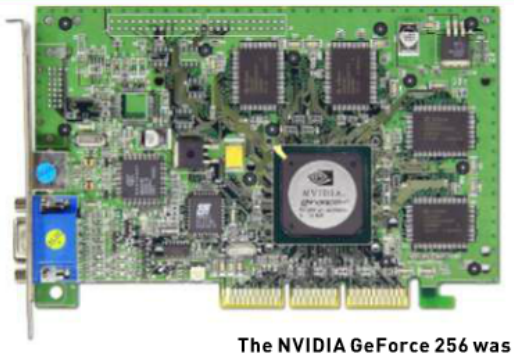
DIRECTX 3.0

DirectX 3.0 was released in September 1996, roughly one year after the original and only four months after DirectX 2.0. DirectX 3.0 was the first significant update to DirectX and brought with it new versions of DirectPlay, DirectInput, DirectSound, DirectDraw, and Direct3D. In its press release announcing the availability of DirectX 3.0, Microsoft claimed, "DirectX 3.0 opens a new dimension in gaming by enabling multiplayer online games, 3-D positional sound, and support for new types of input devices and peripherals." And Microsoft was right. By the time the next version of DirectX was released, hundreds of games, components, and peripherals leveraged the technologies available in DirectX 3.0.

The version of DirectInput included with DirectX 3.0 ushered in support for USB-based game controllers, like the Microsoft Sidewinder Freestyle Pro.

DIRECTX 5.0

Initially released in August 1997, DirectX 5.0 was touted as the first unified version of Microsoft's graphics and multimedia API, with support for both Windows 95 and Windows NT 5.0–based systems. However, Windows NT 5.0—which ultimately became known as Windows 2000—wasn't released until over a year later. Like previous updates, DirectX 5.0 brought with it newer, more capable versions of DirectPlay, DirectInput, DirectSound, DirectDraw, and Direct3D, etc., but it also added support for multiple monitors, AGP-based (Advanced Graphics Port) 3D accelerators, video port extensions (VPE), USB audio, and improved support for USB joysticks.



The NVIDIA GeForce 256 was the first GPU to feature hardware-accelerated transformation and lighting.

DIRECTX 7.0

DirectX 7.0 was another major update to the API, adding support for cutting-edge graphics technologies. The initial version hit in September 1999, and included advancements like support for hardware-accelerated transformation and lighting (Hardware T&L) and environment mapping, two features that allowed game developers to create much more realistic and richer environments. In addition to its new graphics-related chops, DirectX 7.0 also featured new 3D sound algorithms, hardware acceleration for DirectMusic on compatible audio processors, and language support for the Microsoft Visual Basic API development platform, which allowed VB developers to employ a more familiar programming language when using the DirectX Software Development Kit (SDK).

DIRECTX 8.1

Microsoft updated the DirectX logo with a more modern-looking X design that foreshadowed the first Xbox chassis.

Though technically it's just a point release, we're including 2001's DirectX 8.1 on this list for a couple of reasons. First, DirectX 8.1 was the cut-off point for Windows 95—DirectX 8.1 was exclusive to Windows 98 and newer versions of the OS. Second, DirectX 8.1 was also the initial version of DirectX used for the original Xbox game console's development environment. DirectX 8.1 was also significant in that it offered support for new pixel shader models (1.2–1.4) over and above the pixel and vertex shader support in DirectX 8.0, higher-precision texture formats and dynamic textures, and a host of other new features.

DIRECTX 9.0

Many of the most popular games released for the PC, like Valve's *Left 4 Dead* series, leverage technologies introduced with DirectX 9.0.

DirectX 9.0, which was first released in December 2002 and last updated in 2008, is arguably the most successful and pervasive version of Microsoft's gaming and multimedia API. DirectX 9.0 brought support for a wide range of important features, but it also offered a more developer-friendly environment, thanks to a revamped sample browser, which made it easier for devs to access code samples, documentation, and projects. The list of new features introduced with DirectX 9.0 is too long to cover here, but it includes notables like a new high-level shading language (HLSL) for shader programming, support for tessellation, displacement maps, multiple render targets, and 16-bit floating-point vertex and texture formats. And the list goes on and on. DirectX 9.0 was so feature-rich and capable that 12 years removed from its initial release, many new games and game engines still use it.

DIRECTX 11

***Crysis 3* is one of the more ultra-realistic DirectX 11 titles, accomplished by its use of high-res textures, complex lighting and shaders, and detailed models.**

DirectX 11 took everything that was good about DirectX 9.0 and cranked it up a few notches. First released in October 2009 to supplant the stillborn DirectX 10, DirectX 11 included major new additions like DirectCompute for GPGPU support, better support for tessellation, and improved multithreading support to more efficiently leverage the compute resources available in modern multi-core processors. DirectX 11.0 also required the latest GPUs with support for Hardware Tessellation and Shader Model 5.0. The latest version of DirectX 11, version 11.2, is what's included in Windows 8.1 and Windows RT, and will likely be the last update until the recently announced DirectX 12 arrives.

A port of the Xbox One version of *Forza 5* was the first DirectX 12 title to be shown live at Microsoft's launch event at this year's Game Developers Conference.

DIRECTX 12

Although DirectX 12 hasn't been released yet, and it is still unclear which operating systems Microsoft will be supporting (Windows 8.1 and newer are safe bets), it must be included in this list. DirectX 12 will be a radical overhaul of Microsoft's gaming API, which will give developers "closer to the metal" access to hardware, much like AMD's Mantle. DirectX 12 is designed to minimize or eliminate much of the overhead associated with earlier, higher-level versions of DirectX, which should in turn allow developers to better take advantage of cutting-edge features available in the latest GPUs, and wring more performance from the hardware. It will, however, come with a steeper learning curve, as DirectX 12 requires new coding methods. DirectX 12 will be coming to PCs and the Xbox One sometime next year.

IFIXIT presents:

AUTOPSY

THIS MONTH WE DISSECT...

Samsung Galaxy S5

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

BACKGROUND:

Every so often, our Earth-bound teardown team gazes skyward. Today, we look to take the Samsung Galaxy S5 to pieces. Will this device be immortalized among the stars of repairability—or will it plummet to the ground like a blazing meteorite?

MAJOR TECH SPECS:

- 5.1-inch Super AMOLED display (1920x1080, 432ppi)
- 16MP rear camera with 4K video at 30fps; 2MP front-facing camera with 1080p video and wide-angle lens
- Sensors for fingerprint, heart rate, gestures
- 2.5GHz quad-core Snapdragon 801 processor, 2GB LPDDR3 RAM
- 16/32GB internal memory, plus microSD up to 128GB
- LTE, NFC, Bluetooth 4.0 BLE, Micro-USB 3.0, 802.11ac MIMO Wi-Fi

KEY FINDINGS:

- Visible beneath the 16-megapixel rear camera: a heart rate monitor. Useful when you need to monitor your heart rate from your smartphone. So, basically, all the time.
- The silver bay is a Micro-B USB 3.0.
- Samsung seems to be promoting the DIY lifestyle. Not only is the battery replaceable, it needs to be user-installed. We pull the battery out of its fancy packaging to reveal it is a 3.85V, 10.78Wh model. Samsung touted a better battery-saving mode, but didn't specify life in its advertising—just listing the spec as 2,800mAh. A slight upgrade from the S4's 3.8V 2,600mAh (9.88Wh) battery, it's advertised at seven hours of talk time, and up to 12.5 days of standby.
- A large quantity of sticky adhesive tape holds down the screen. Reinstalling will most likely require a fresh set of adhesive.
- Repairability score: 5 out of 10 (10 is easiest to repair). The battery is incredibly easy to remove and replace, and the display is one of the first components out, making replacements a little faster. However, it is held in with a significant amount of adhesive and requires very careful and persistent prying and a considerable amount of heat to remove without cracking the glass or cutting cables. Once you get the device open, several components are modular and fairly easy to replace, such as the cameras, headphone jack, vibrator motor, and speakers. But replacing anything other than the battery requires first removing the display, risking extra damage on the way to a repair.

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Asus 31.5-inch panel boasts four times the resolution of 1080p PG. 76
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Seven 802.11ac Wi-Fi routers demo the new spec's capabilities PG. 34
ASROCK M8
Build your own micro-tower with this BMW-designed bare-bones kit PG. 74
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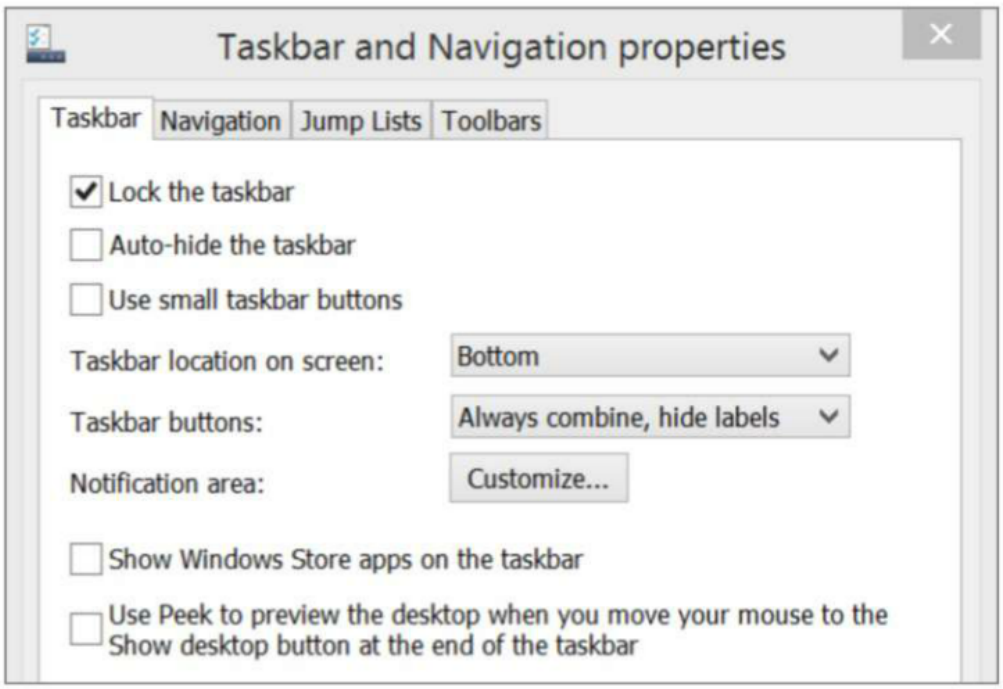
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

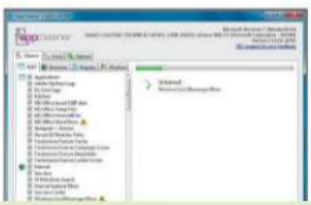
WINDOWS TIP OF THE MONTH



DISABLE THE TASKBAR IN WINDOWS 8.1 METRO APPS

The latest patch for Windows 8.1 has made Metro apps work more like traditional desktop applications—move your mouse to the bottom of the screen and the taskbar will appear. If you don't like this change, right-click on the taskbar, click Properties, and uncheck the box marked "Show Windows Store apps on the taskbar."

MAKE - USE - CREATE



64 Make Your Facebook Account Super Secure

66 Quickly Reclaim Disk Space with AppCleaner

ALEX CASTLE
CONTRIBUTING EDITOR

SOCIAL NETWORK SECURITY

THIS MONTH, we're running a how-to that's a little out of the ordinary for *Maximum PC*. You'll find it on the next page—it's Matt Hanson's guide to Facebook security. Normally, a guide to using an online service like Facebook would be a little below the skill level we target in *Maximum PC*, but I think this one's worth running for a couple of reasons. First and foremost, I think it's a really important topic, and one that a lot of people don't take seriously enough. It's getting very hard to safeguard your privacy in the modern, data-mining world, and Facebook's probably the worst offender of all. Even if you'd prefer just to stay clear of Facebook entirely, there's a lot of pressure to maintain a presence on the network just so your extended family won't think you're trying to avoid them.

Second, Facebook's privacy tools are more sophisticated than you might imagine. The tools aren't promoted as heavily as they should be on Facebook itself, but they give you a lot of options for keeping your private info away from prying eyes. So check out the article, and make sure you're doing everything you can to stay safe.

↘ submit your How To project idea to: comments@maximumpc.com

Make Your Facebook Account Super Secure

YOU'LL NEED THIS

A FACEBOOK ACCOUNT
If you don't use Facebook, this article's not for you!

FACEBOOK HAS JUST celebrated its 10th birthday, and in that time it has amassed over a billion monthly active users. It's a great place to share photos and information with friends and family, but whenever you share personal details online, you should always be aware of who can see it, and the privacy settings available.

For example, most people put their full name, date of birth, phone number, and even address on their Facebook profile without a second thought. All this data could be used by someone to commit identify theft, posing as you and using your identity to open credit cards and more. Facebook has a surprising number of privacy tools that can keep your information safe, while still allowing friends to see your profile. Some options aren't easy to find, though, so we'll show you every step you can take to make your Facebook profile completely secure. –MATT HANSON

1 LOG IN AND SEE WHAT YOU'RE SHARING

We don't need to tell you how to log in to Facebook, but when you log in to your account from a shared or public computer, make sure you don't check the box labeled "Keep me logged in." It's an option we sometimes choose without thinking, and it's fine for home PCs, but you don't want someone else accessing your account after you've stopped using the PC.

» Facebook has recently implemented a number of changes to make its privacy settings easy to access. To see them, click the padlock icon on the top right-hand corner and a drop-down list containing the most popular privacy settings is displayed (**Image A**). These aren't all your options though—you can also click "See more settings" for even more privacy tools.

» Before you begin tweaking privacy settings, check how much information you're sharing, and with whom. Click the arrows next to "Who can see my stuff?" and "What do other people see on my timeline?," then click "View As" (**Image B**). Initially, you'll see what your profile looks like to people you don't know. Make note of any information you're not comfortable sharing with strangers.

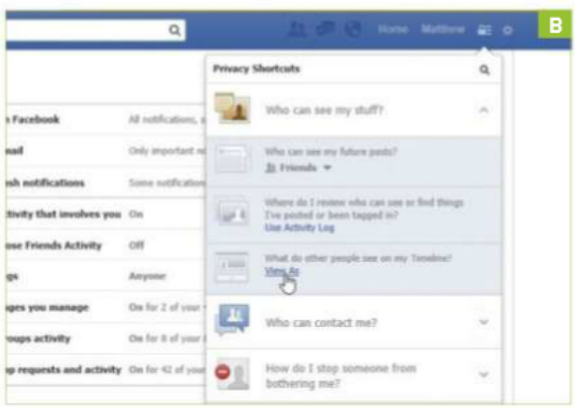
2 LIMIT WHAT PEOPLE CAN SEE

Now that you know what you're sharing, you can do something about it. First, limit who sees what you post. Status updates can include what you're doing, who you're with, and where you are, so it's a good idea to limit them to people you know. Click the privacy icon, then click the arrow by "Who can see my stuff?" and under "Who can see my future posts?" select "Friends" from the list.

» It's one thing to be careful about what you post about yourself, but what about friends who tag you in their posts? You can set Facebook to alert you when that happens, and if you're happy with what they've posted, you can allow it on your timeline. If not, you can choose to un-tag yourself. To get started, click "See more settings," then "Timeline and tagging."

» There's an option on this screen called "Review posts friends tag you in before they appear on your timeline?" Click "Edit" and select "Enabled" (**Image C**). By "Who can see posts you've been tagged in on your timeline?" click 'Edit' and select "Friends" or, for more security, "Only me." Next, by "Review tags people add to your own posts before the tags appear on Facebook?" click "Edit," then "Enabled."

» From now on, when someone tags you, you'll be asked to review the tag. This appears as a notification, but you can check it manually by clicking the "Privacy" icon, expanding "Who can see my stuff?" and selecting "Use activity log." Click "Tag review" to see things you've been tagged in, then "Add tag" to be associated with it (which other people can see), or "Ignore" to keep it off your timeline.



C
Review posts friends tag you in before they appear on your timeline?
Timeline Review controls whether you have to manually approve posts you're tagged in before they go on your timeline. When you have a post to review, just click Timeline Review on the left-hand side of your Activity Log.
Note: This only controls what's allowed on your timeline. Posts you're tagged in still appear in search, news feed and other places on Facebook
Enabled
Add to Timeline
Hide

3 CHOOSE WHO CAN FRIEND YOU AND FIND YOU IN SEARCH

Some people see Facebook as a competition to get as many friends as possible, but this can be dangerous, as you don't want strangers seeing all your information. From the Privacy menu, expand "Who can contact me?," then under "Who can send me friend requests" you can choose only "Friends of friends"—people your friends know—to be able to send you a friend request (**Image D**).

» Another tactic to make sure your account is only accessible to people you know is to limit who can search and find your account. From the Privacy menu, click "More settings." Next to "Who can look you up using the email address you provided" and "Who can look you up using the phone number you provided," click "Edit" and select "Friends" or "Friends of friends."

» These privacy settings are all well and good, but they don't do much if anyone can just type your name into Google, or any other search engine, and find your profile. From the same screen we used in step 2, where it says "Do you want other search engines to link to your timeline" click "Edit," and make sure the box next to "Let other search engines link to your timeline" is unchecked (**Image E**).

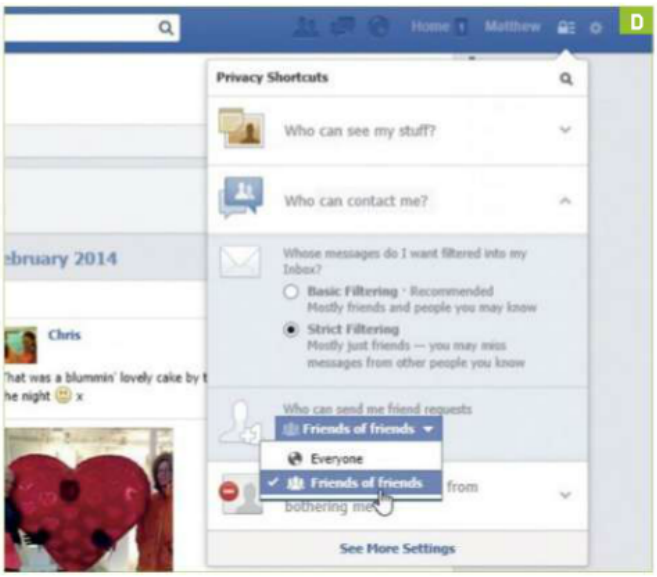
4 ADDITIONAL SECURITY MEASURES

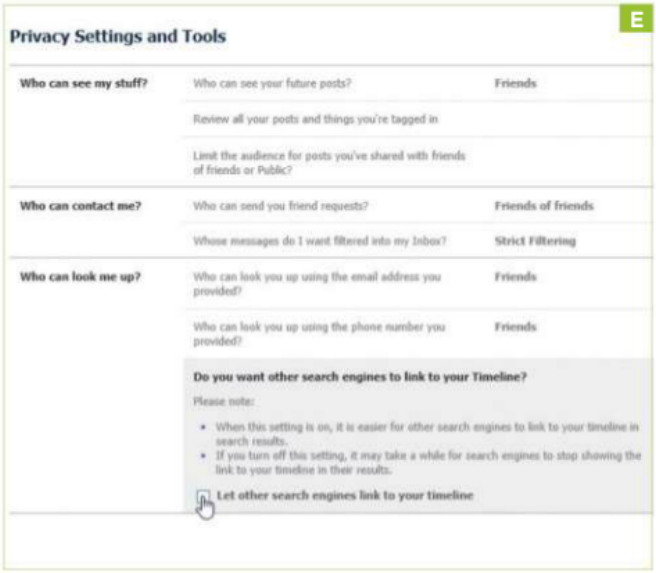
You may want to make sure your online activity is secret, which is where secure browsing comes in. When on Facebook, look at the address bar of your browser. If the URL begins with "https://" you're secure, but if it starts with "http://" browse to the "More Settings" screen and click "Security" on the left. Next to "Secure browsing," click "Edit," then check the box to enable secure browsing.

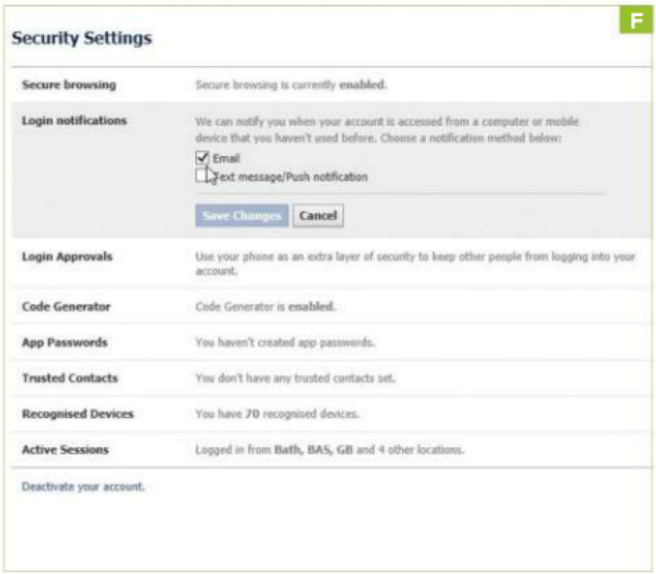
» The most important aspect of Facebook security is making sure only you can log in to your account, and you're informed if someone tries to log in as you. Enable "Login notifications" from the Security Settings menu (**Image F**). This emails or texts you if your account is accessed from a device you haven't used before. You can see all the devices you've allowed access under "Recognized Devices."

» One of the best ways to keep your account secure is to use a strong password—ideally a mixture of upper- and lower-case letters, and numbers. The more complex it is, the harder it will be for a malicious user to crack. For even more security, enable Login Approvals. Whenever you log in from a new device, a message is sent to your phone allowing you to approve the login.

» Now that you've followed these steps, you can breathe a sigh of relief—your Facebook account is as secure as possible. Make sure you pay attention to any notices you get telling you someone has logged into your account—if you don't recognize the device, make sure you change your password. To do this, go to "More Settings > General" and click "Edit" next to "Password."


D
Privacy Shortcuts
Who can see my stuff?
Who can contact me?
Whose messages do I want filtered into my Inbox?
Basic Filtering · Recommended
Mostly friends and people you may know
Strict Filtering
Mostly just friends — you may miss messages from other people you know
Who can send me friend requests
Friends of friends
Everyone
Friends of friends
See More Settings


E
Privacy Settings and Tools
Who can see my stuff?
Who can see your future posts?
Friends
Review all your posts and things you're tagged in
Limit the audience for posts you've shared with friends of friends or Public?
Who can contact me?
Who can send you friend requests?
Friends of friends
Whose messages do I want filtered into my Inbox?
Strict Filtering
Who can look me up?
Who can look you up using the email address you provided?
Friends
Who can look you up using the phone number you provided?
Friends
Do you want other search engines to link to your Timeline?
Please note:
When this setting is on, it is easier for other search engines to link to your timeline in search results.
If you turn off this setting, it may take a while for search engines to stop showing the link to your timeline in their results.
Let other search engines link to your timeline


F
Security Settings
Secure browsing
Secure browsing is currently enabled.
Login notifications
We can notify you when your account is accessed from a computer or mobile device that you haven't used before. Choose a notification method below:
Email
Text message/Push notification
Save Changes
Cancel
Login Approvals
Use your phone as an extra layer of security to keep other people from logging into your account.
Code Generator
Code Generator is enabled.
App Passwords
You haven't created app passwords.
Trusted Contacts
You don't have any trusted contacts set.
Recognised Devices
You have 70 recognised devices.
Active Sessions
Logged in from Bath, BAS, GB and 4 other locations.
Deactivate your account.

Quickly Reclaim Disk Space with AppCleaner

YOU'LL NEED THIS

APPCLEANER

This free cleaner application includes a number of useful functions. Get it at http://bit.ly/MPC_appcleaner.

WHEN YOUR PC starts to run sluggishly, it can be very frustrating. Fortunately, there are plenty of ways that you can solve the problem. But with so many apps out there offering to clean your Registry or remove unwanted programs, it can be tricky to find the correct tool for the job. This is why many software companies make all-in-one programs that tackle the main areas that cause poor computer performance.

One of the best in this crop of system utilities is AppCleaner from UpdateStar. Like most all-in-one cleaners, you will find features such as Registry cleaning, hard disk cleaning, and temporary file removal, but AppCleaner also includes cleaning of third party software. This is an excellent addition that makes the software stand out that little bit more from the crowd. Here, we'll show you exactly how to use it. –SIMON ARBLASTER

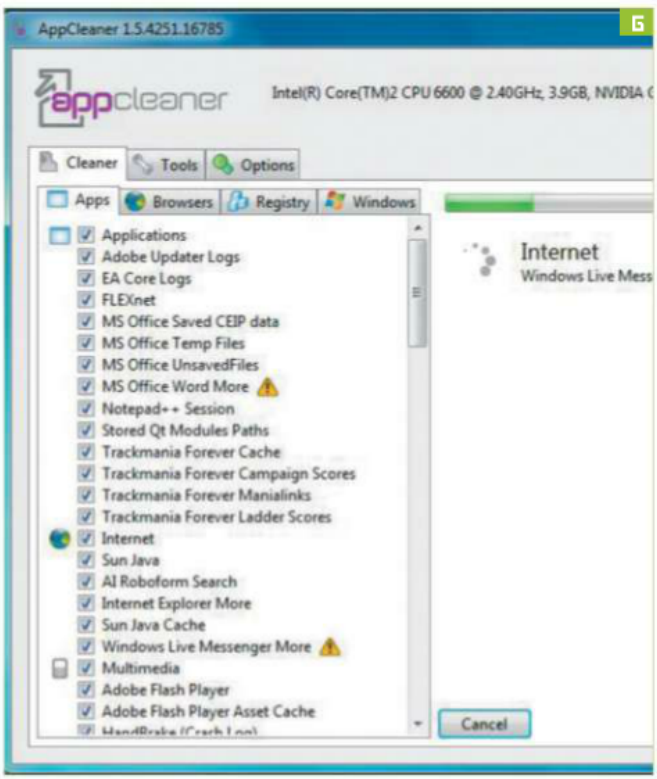
1 SCANNING YOUR APPS

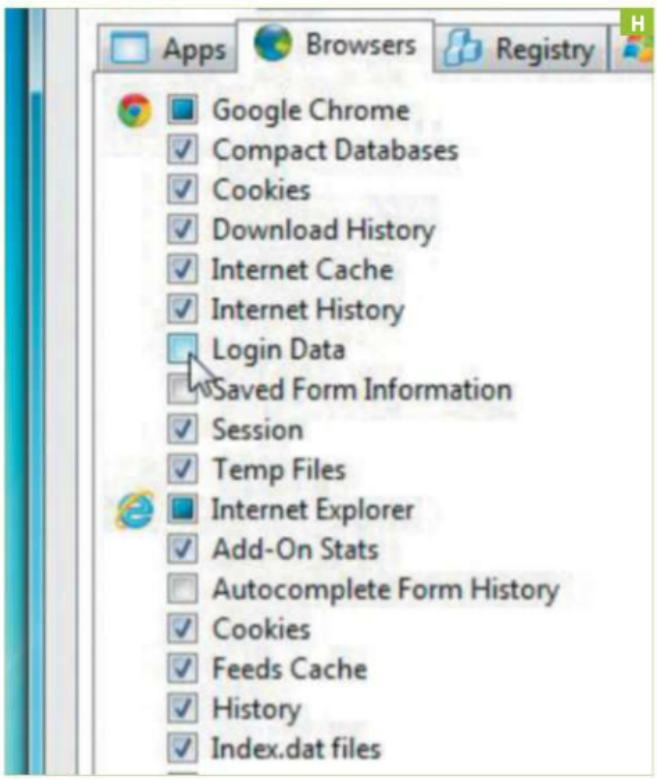
First, you'll need to install the program. AppCleaner is available for free online at http://bit.ly/MPC_appcleaner. Simply download the file and run the installer, or if you like you can download the portable version, which doesn't require any installation. The portable version is an excellent choice to keep on a USB thumb drive in case of computer emergencies.

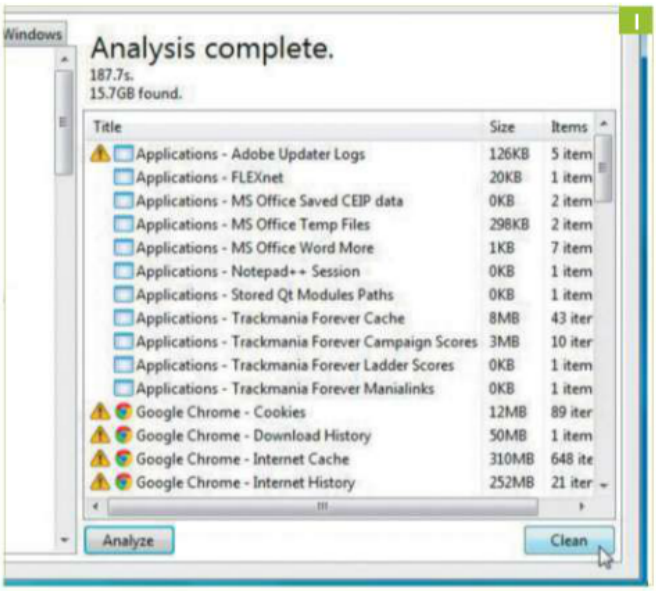
» The first time that the program runs, it goes straight to cleaning your apps (Image G). It will scan all your apps, looking for garbage data created by that app that can be safely erased to reclaim hard drive space. You can either choose to select each application individually or select all of them at once. If, like us, you have a healthy number of programs installed on your system, analyzing all of them may take quite a bit of time.

» Under each tab (Apps, Browser, Registry, and Windows) you will find even more entries that can be scanned. By default, not all of these entries are selected. It's up to you to select the ones that you wish to add or remove. If you're unsure of what to have scanned, a good generic option to select all the boxes in all but the Windows tab.

» Even though you will want to get rid of most of your unwanted files, there may still be a few you might want to keep. In the case of your Internet browser, you may wish to keep saved passwords and other auto-complete data. Be sure to un-tick those boxes to make sure you don't lose them (Image H).






Windows
Analysis complete.
187.7s.
15.7GB found.
Title
Size
Items
Applications - Adobe Updater Logs 126KB 5 item
Applications - FLEXnet 20KB 1 item
Applications - MS Office Saved CEIP data 0KB 2 item
Applications - MS Office Temp Files 298KB 2 item
Applications - MS Office Word More 1KB 7 item
Applications - Notepad++ Session 0KB 1 item
Applications - Stored Qt Modules Paths 0KB 1 item
Applications - Trackmania Forever Cache 8MB 43 iter
Applications - Trackmania Forever Campaign Scores 3MB 10 iter
Applications - Trackmania Forever Ladder Scores 0KB 1 item
Applications - Trackmania Forever Manialinks 0KB 1 item
Google Chrome - Cookies 12MB 89 iter
Google Chrome - Download History 50MB 1 item
Google Chrome - Internet Cache 310MB 648 ite
Google Chrome - Internet History 252MB 21 iter
Analyze
Clean
I

appcleaner
Cleaner
Tools
Options
Uninstall
Startup
System Restore
Uninstall
Delete
Search
Name
Publisher
Installed ...
Size
Version
ACID Music Studio 8.0 Sony 07/09/2010 227MB 8.0.178
Adobe AIR Adobe Systems Inc. 06/08/2010 2.0.2.12610
Adobe Community Help Adobe Systems Incorporated 05/04/2011 3.2.1.650
Adobe Flash Player 10 ActiveX Adobe Systems Incorporated 27/07/2011 6MB 10.3.181.26
Adobe Photoshop Elements 8.0 Adobe Systems Incorporated 06/04/2010 1.5GB 8.0
Adobe Photoshop Elements 9 Adobe Systems Incorporated 05/04/2011 2.6GB 9.0
Adobe Shockwave Player 11.5 Adobe Systems, Inc. 27/01/2011 11.5.9.615
AKVIS Retoucher AKVIS 23/08/2011 29MB 5.0.838.7812
Alien Skin Image Doctor 2 Alien Skin Software 29/07/2011
AppCleaner UpdateStar GmbH 31/08/2011 1.5.4251.16785
Apple Application Support Apple Inc. 28/03/2011 50MB 1.5.0
Apple Mobile Device Support Apple Inc. 28/03/2011 22MB 3.4.0.25
Apple Software Update Apple Inc. 20/04/2010 2MB 2.1.2.120
ASIO4ALL Michael Tippach 19/10/2010 2.10
Audacity 1.2.6 25/02/2011
Backdrop Designer Digital Anarchy, Inc. 05/04/2011 1.5
Beauty Box Digital Anarchy, Inc. 29/03/2011 1.2.2
BlackMagic ACN 064 583 633 T/A Neuraltek 10/08/2011 3MB 2.86.0001
J

2 CLEARING UP SPACE

Once analysis is complete, you will see the list of files in the main window (**Image I**). Some of the entries will have a warning sign next to them. Don't worry, this just means that AppCleaner can't clean these files at this current time. You should, however, be able to clean them when those programs are not in use.

» To complete the process of cleaning your apps, click Clean at the bottom right-hand corner of the screen. You will now be prompted to back up all the entries that will be erased from the Registry. It would be very wise to do this in case a program becomes unstable and you need to roll back the changes.

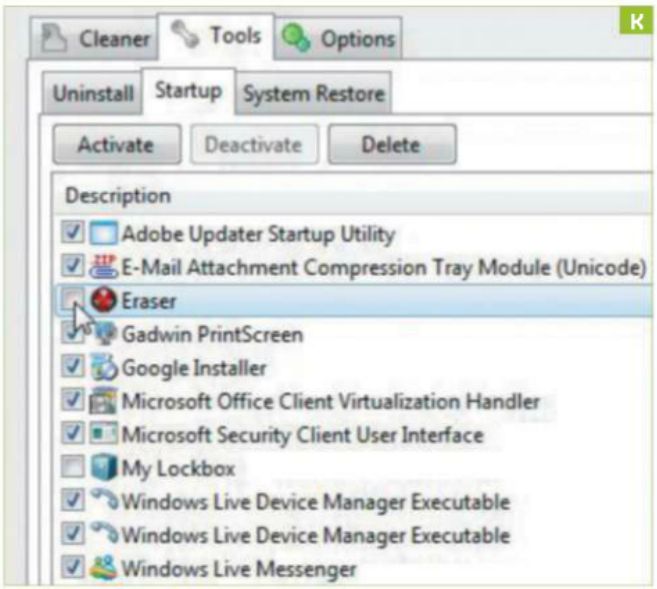
» Now that all of the application cleaning is complete, AppCleaner will give you the total space saved on your system. If you've got a lot of programs installed on your computer, you could be looking at gigabytes of space saved.

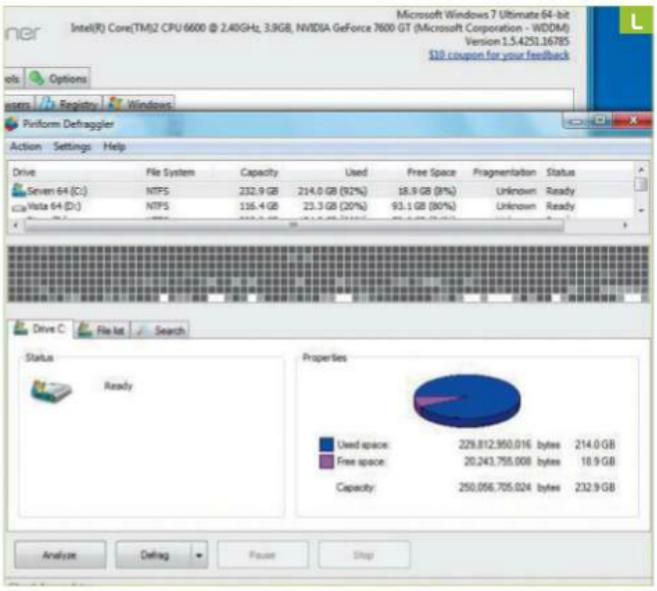
3 OTHER APPCLEANER TOOLS

Once you've cleaned out all the files you want, you can move on to other tools featured in AppCleaner. Under the Tools section is the Uninstall tab, which allows you to remove programs. All of your installed programs are listed. All you need to do is select the program you wish to remove and click on the Uninstall button (**Image J**).

» The next tab in the Tools section is called Startup and includes a list of all the programs that start up with Windows. You will want most of these apps to start up with your computer, but there may be a couple that can be removed. Simply uncheck the box next to the corresponding program to deactivate it (**Image K**).

» You may already have noticed your system is running much better, especially if you were perilously close to a full hard drive. One final thing you can do is defrag your hard drive. To do so, you can use either the Windows system tool, or try the excellent offering from Piriform called Defraggler (**Image L**), available at http://bit.ly/MPC_defraggler. Both will do the job, but we prefer Defraggler's features and interface. Now, enjoy your speedy PC!





BUILD IT

BY TOM MCNAMARA

Maximizing Performance Per Square Inch

We cram two radiators, five fans, a dual-GPU video card, and an 850-watt power supply into a micro-ATX cube—no big deal

LENGTH OF TIME: **2–4 HOURS** LEVEL OF DIFFICULTY: **MEDIUM**

THE MISSION Anyone can put some fancy gear into a regular tower case. It's like Lego, but not as expensive. With the growing trend toward shrinking cases, we like to challenge ourselves by maintaining silly amounts of performance within small real estate. We tried this route with a recent Build It, featuring a mini-ITX tower from Silverstone and a GTX 780 Ti video card from Nvidia, but there just wasn't enough physical space for the system to really shine. To achieve the power and cooling that we really wanted, we needed a bigger boat. This micro-ATX box is arguably our craziest attempt yet—not just in terms of how much mojo we've wedged in there, but also in how close this build came to not working at all. We discovered that there was pretty much no margin for error, and a slightly different selection of hardware probably would have meant failure to launch. Some of it we got lucky with, while other things we had to replace or scrounge for. But we clawed our way to victory, because the idea was too audacious to merely daydream about.

JUMBO SHRIMP

WE NEEDED A SOLID foundation to house a card as beefy as a Radeon R9 295X2, which squeezes two 290X GPUs onto one dual-slot card and cools itself with an integrated 120mm closed-loop liquid cooler (CLC). We also decided on a 240mm CLC for our Intel Core i7-4770K. And the 295X2 alone would need a full-sized ATX power supply. But there aren't a lot of cases that can wrangle all this hardware and still provide enough ventilation to keep everyone happy. Luckily, we'd recently received a micro-ATX Bitfenix Colossus Mini, a shrink-ray version of the company's full-tower case. Not to be confused with the mini-ITX Mini, which is even mini-er. Our Mini had enough fan mounts and just enough internal real estate to close the deal. Barely. After some experimentation (explained later), we settled on the Lepa G850-MAS power supply, an 850-watt unit. This PSU fit the bill because its cables are clustered to one side of the unit, and it's been well-reviewed. Being a "gold" rated PSU didn't hurt, either. We needed a lot of power efficiency to make this build work. Our CPU got a Cooler Master Glacer 240L, a CLC with a 240mm radiator, to keep it nice and chilly. The connectors on the radiator end can swivel for a level of flexibility that you don't usually see with this type of unit. Our motherboard of choice was a micro-ATX Gigabyte Z97M-D3H, which gave us some ergonomic flexibility later on.

INGREDIENTS

	PART	PRICE
Case	Micro-ATX Bitfenix Colossus Mini	$110
PSU	Lepa G850-MAS	$170
Mobo	Gigabyte GA-Z97M-D3H	$115
CPU	Intel Core i7-4770K	$320
Cooler	Cooler Master Glacer 240L	$120
GPU	AMD Radeon R9 295X2	$1,500
RAM	2x8GB Corsair Vengeance DDR3/1600	$70
SSD	Samsung 840 Pro 500GB	$255
Case Fan	2x 120mm Enermax TB Vegas	$30
Fan Cable	Silverstone CPF01 PWM Fan Splitter	$5
OS	Windows 8.1 64-bit OEM	$100
Total		$2,795

1 I'M YOUR BIGGEST FAN

THE BITFENIX COLOSSUS Mini comes with two 120mm stock fans. We removed them both and replaced them with a pair of Enermax T.B. Vegas fans that we wanted to test. This upgrades us from 3-pin to 4-pin fans, allowing us to control their speed ranges with instructions given to the motherboard. We salvaged a 4-pin splitter cable from a CLC kit to plug both fans into one mobo fan header. These fans install in the bottom as intakes, with their screws coming in from below. We added chrome grills to keep the blades from getting caught on anything. Safety first! You could also install a single 230mm fan in this spot instead.

2 INSTALL THE COOLER

WE KNEW WE NEEDED a boatload of power to handle this kind of gear, so we aimed for at least 850 watts. At the same time, the power supply couldn't be too beefy, because a 295X stretches across the entire length of this case and could obstruct the unit. Even with our connectors clustered to the left, we barely got the card to slide past the cables. It still blocks two connectors, but the two PCIe cables and the SATA power cable that we can attach are plenty for our purposes. The SATA cable will power an SSD and the CLC's pump. There's a second 8-pin CPU power cable coming out the back that we won't be using, but there's space to tuck it away on the other side of the PSU. Unfortunately, there isn't anywhere else to tuck other cables out of sight, but the Colossus Mini doesn't have a side window to expose our messy internals.

3 SEEING DOUBLE

PUTTING IN THE VIDEO CARD isn't as hard as it looks. It just needs to go in before the CPU's radiator does. The others cables pictured can be pulled out of the way. The tightest fit in this section was actually the card's own radiator, which gets close enough to the 295X2 to graze its backplate. Turned 180 degrees, the rad would not fit. If the card was fatter than normal, the tubing on the radiator above it might not be bendy enough to get around. If the card were too tall, it would block our critical power supply connectors. Basically, AMD's reference dimensions were critical to our success.

4 X MARKS THE SPOT

THE X-SHAPED BRACKET pictured is the backplate for our Cooler Master's Glacer 240L CPU cooler. This installation process became, shall we say, an enlightening challenge when confined to a Colossus Mini that was starting to fill up with hardware. In retrospect, installing the cooler first probably would have been better. The bracket doesn't stick through the other side of the motherboard, so it's difficult to fasten the heatsink's bracket to it. The backplate's adhesive pads are also very small and not very effective. Still, we were able to squeeze a 4.4GHz overclock out of our Core i7-4770K CPU, despite it competing with the video card for intake. The Gigabyte Z97M-D3H micro-ATX board is not a fancy unit, so we didn't expect record-breaking OCs anyway. The cooler's 240mm radiator also ended up blocking the other PCI Express slot on the motherboard when we installed it in the top of the case, so it turns out that a dual-GPU card was the best option after all.

5 DO YOU EVEN FLIP

THE COOLER MASTER 240L comes with its fans preinstalled on the radiator, which has become increasingly popular. CM also attached the fans with small screws that can only be reached by a screwdriver with a narrow shaft. We had a Snap-On kit that fit the bill. We needed to flip the fans so that they would be pulling heat off the radiator and blowing it out of the case, instead of fighting the video card for intake. How is this possible? Well, the Colossus Mini has an inverted motherboard tray, so the mobo goes in upside down—putting the video card right below the 240L. This also put a bunch of USB, front-panel, and audio connectors at the top of the case, so we had to hook up those before they were blocked by the 240L's rad. This meant reversing the Colossus Mini's side panels, which is why the white stripes on the side don't line up with the white stripe on the front; the case's power button is located on a side panel instead, making wiring a bit challenging with our jam-packed system.

6 RADICAL ENGINEERING

INSTALLING THE VIDEO CARD'S radiator was pretty easy by comparison. We had already installed the CPU's heatsink with its tubing on the opposite side of the video card radiator's mount point. That way, the heatsink could be removed later, without having to take out the rad first. The cable for its pre-attached 120mm fan is wired directly into the card and gets power right off of the PCI Express bus, which is a smart way of eliminating the need for an extra fan header on the motherboard. Likely buyers of this board will probably be using a lot of fan headers already, and this design keeps the cabling clean for showing off to your friends and neighbors. Our non-retail version of the card didn't come with mounting screws (the retail one does), but power-supply screws worked perfectly and are commonly found on most builders' workbenches. The part of the rad where the tubes goes in has some bulk, so it has to be on the bottom. There's literally no room to rotate it, because the video card is right there.

1. The connectors on this radiator can rotate a full 360 degrees, so maneuvering them around the video card wasn't a problem.

2. The 5.25-inch drive bay is secured with six screws, so we just pulled it out to make way for this 12.5-inch long video card.

3. The front of the case has a large grill that the power supply uses as an intake, helping it run coolly and efficiently.

4. The rear of the case will fit a 140mm fan, but case fans installed right below would probably block a 140mm radiator.

THE LITTLE ENGINE THAT COULD

WERE IT NOT FOR OUR library of spare parts, this build might not have come together. The flip side is that we sometimes use a part or two that's hard to find at retail, like our Lepa G850-MAS, so the build ends up an experiment instead of something you could replicate. If you have a PSU that's semi-modular or non-modular, no longer than 6.3 inches, and provides about 850 watts or more, and its modular connectors are clustered close to the motherboard power cable, you may be in luck.

As for our storage devices, there's a metal plate for that, which screws in above the motherboard, and leaving it in during photography would have blocked the view of everything inside. Since it's just a plate with drive mounts on it, we simply left it out of the shots. But we can tell you that it could fit two 2.5-inch drives and one 3.5-inch drive. Your connectors can't go in at right angles, though, because the rear of the drive doesn't end up flush against the edge of the plate. Hopefully, Bitfenix will consider changing that in later versions of this case.

But you're probably wondering what the build felt like once it was finally up and running. Well, with two 290X GPUs along for the ride, we could max out all our game settings even at Ultra HD (aka 4K) res. We did usually disable anti-aliasing, because the much higher pixel density at 3840x2160 gains minimal visual improvements from AA but has a high performance cost. AMD's drivers also let us attempt to force Crossfire (the company's version of SLI) when a game didn't have a CF profile written for it, so that was nice. The motherboard handled a CPU overclock of 4.4GHz without breaking a sweat, keeping us surprisingly close to the zero-point machine's hex-core Core i7-3930K.

The fans on the 240mm radiator did get louder than we'd like. Even with the motherboard instructed to use a "silent" mode, the fans still cranked up to about 1,800rpm under load. The video card's radiator fan hardly made a peep, despite the card never hitting 70 degrees Celsius, so we know that the system was getting plenty of air. It could be that the 240L was fighting the 295's intake fan for air, despite the 240L's fans being on the other side of the rad. But overall, the build felt like a success, and we enjoyed learning more about space management.

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS6 (sec)	2,000	2,326 (-14%)
Stitch.Efx 2.0 (sec)	831	730
ProShow Producer 5.0 (sec)	1,446	1,225
x264 HD 5.0 (fps)	21.1	19.2 (-9%)
Batman: Arkham City (fps)	76	132
3DMark11 Extreme	5,847	8,371

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The zero-point machine compared here consists of a 3.2GHz Core i7-3930K and 16GB of Corsair DDR3/1600 on an Asus P9X79 Deluxe motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.

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hand-built in the USA
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REVIEWS

TESTED. REVIEWED. VERDICTIZED.

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ORIGIN PC GENESIS
PAGE 74

The Genesis can be configured with the GPUs on the left or right side, and vertically or horizontally.

Origin PC Genesis

Modular without screaming 'Lego set'

WE ALL KNOW the PC OEM business is a commodity parts game with every vendor having the exact same access to PC hardware as everyone else. It's a bit like trying to impress the paparazzi on the red carpet with the same off-the-rack dress as every other starlet.

That's why in every OEM's life comes the time to design their own custom chassis. That time, it appears, has now come for Origin PC and its truly unique modular case.

We've seen modular case designs before—the most notable being Cooler Master's HAF Stacker series—but Origin's case goes beyond even Cooler Master's design. The Genesis can be configured as a midtower or a full-tower case by bolting on an expansion bay that can support radiators or hard drives. Unlike the HAF Stacker's Lego-like feel, the Origin's design is far more integrated. In fact, you'd never know the bottom was bolted in place. Even more impressive is the ability for the case to be configured with the motherboard tray in a horizontal or vertical direction and on either the left or right side of the chassis.

Some have pooh-poohed such flexibility as unnecessary, but it can work wonders for someone who wants to hardware-peep the machine but place the system to their left side. Don't think you can reconfigure it on the fly though—the case orientation is decided before it's built into.

While revolutionary, it isn't perfect. There are a couple areas on the top of the case that feel like the natural choice for picking up the case to move it. If you do, you'll break it. Origin clearly labels these as no-lift areas but we'd rather see these beefed up before a tragedy occurs. We also had clearance issues trying to get our dual-link DVI cable to fit with its large cable choke. These chokes are pretty common to dual-link cables, so you'll have to resort to DisplayLink if you want to make it work. The case door is also "oversprung," in that Origin embedded two springs to assist in opening the door. Unfortunately, the springs are so strong, the door will often pop completely off the side of the case and smash into the ground.

The case is also surprisingly compact. Whereas custom cases, such as Digital Storm's Aventum II or iBuypower's Erebus XL, are large enough to create their own gravitational fields, the Origin case is almost petite. That didn't stop the company from shoehorning in a massive amount of hardware, though. You'll see the full details below, but we'll give you the notable highlights here: a Core i7-4960X overclocked to 4.4GHz–4.8GHz, four GeForce GTX 780 Ti cards, and an Asus Rampage IV Extreme Black Edition board, all of it custom-cooled with a Origin's Cryogenic liquid cooling using a lot of Koolance hardware.

Of course, performance counts. And the Genesis trades blows with Digital Storm's Aventum II that we reviewed in January. The Aventum II's CPU sat at 4.7GHz while the Genesis mostly runs at 4.65GHz. That makes the two damned near equal on CPU tasks. In gaming though, the Genesis takes the lead as the Aventum II didn't pack liquid-cooled 780 Ti's; they weren't even available back then. That means the Origin Genesis now holds the top spot—although not by much—in the gaming benchmarks. The Genesis even, in fact, surpasses last year's Dream Machine with its liquid-cooled 4-way GeForce Titan setup, so it ain't no slouch.

One thing we must note: Our machine came with a Corsair AX1200i PSU. It's a beefy platinum-rated PSU and we had no issues, but at the wall, we saw the load consistently sit at or near 100 percent load just running Heaven 4.0. Origin says actual gaming will use far less power than synthetic stress tests, but it has also since upgraded to Corsair's new AX1500 PSU. In fact, the pricing actually reflects the upgraded PSU.

Overall, we like the case, love the flexibility, and laud Origin for creating something fairly revolutionary for a case enclosure. It's not perfect, but add in the top-notch performance and superb attention to detail and you have a truly unique machine. **–GORDON MAH UNG**

VERDICT 9

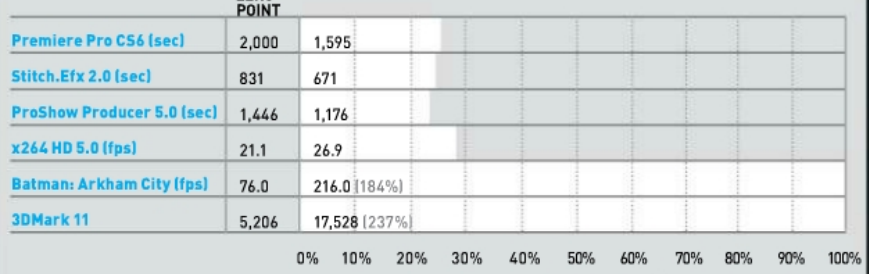
Origin PC Genesis

+ GENESIS PLANET Revolutionary modular case without looking like a Lego set.

– CETI ALPHA V Right at the limit of the PSU; needs to be stronger up top.

$10,265, www.originpc.com

BENCHMARKS



Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

Processor	3.6GHz Core i7-4960X overclocked to 4.65GHz
Mobo	Asus Rampage IV Extreme
RAM	16GB DDR3/1866 Corsair Dominator
Graphics	4x liquid-cooled GeForce GTX 780 Tis
Storage	1TB Samsung 840 EVO SSD, 4TB WD Black HDD, Blu-ray burner
Case / PSU	Custom / Corsair AX1200iAa

Future

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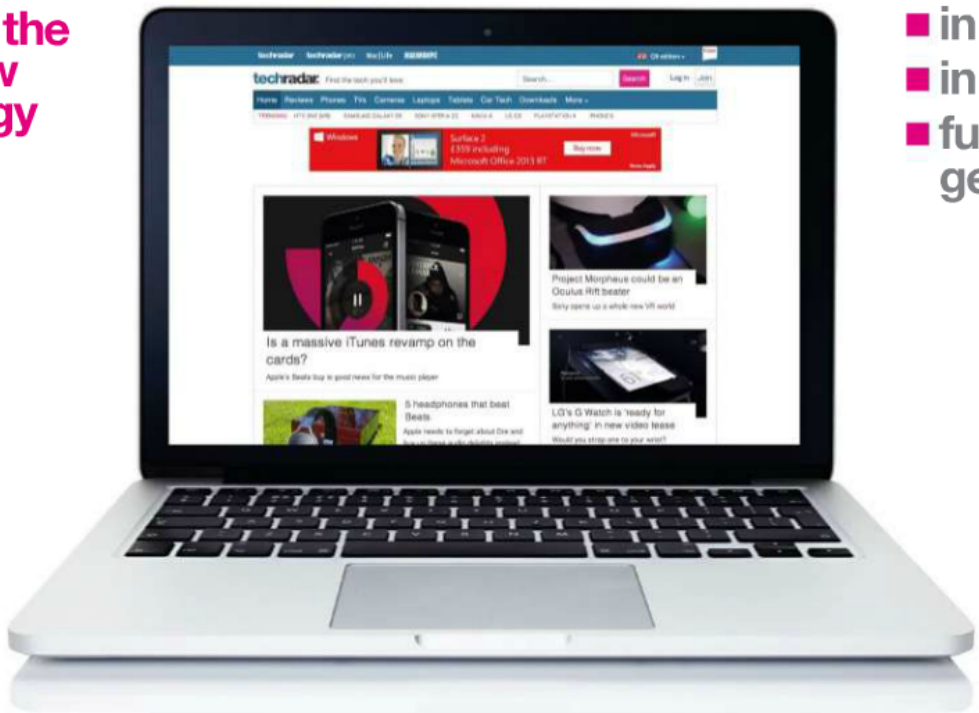
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www.techradar.com

The H Wireless's microphone stores away in the left earcup, and lights up when active.

Steelseries H Wireless

What can $300 buy you in a gaming headset?

THE STEELSERIES Wireless H certainly looks and feels like a top-of-the-line headset. Its design is mercifully subdued, with an all-over black color scheme that looks great even if you're not in the middle of a LAN party. The design is livened up with some very subtle orange accents, and a variety of handsome textures (rubber, leather, matte and gloss plastic) that look and feel superb.

Build quality of the H Wireless is exceptional, as well. The earcups swivel flat so that you can wear them around your neck between matches, and rock in place along the other axis, so they fit securely against your head. For a heavier headset, we found the Wireless H very comfortable even for gaming sessions lasting over two hours.

The most important feature of the H Wireless is, of course, that it's wireless. Where many wireless sets use a small USB dongle to accomplish this, the H Wireless comes with a little wireless receiver that connects to your PC and sits on your desk. It takes up some valuable space, but it's nicely designed and looks especially cool when its crisp, white OLED display is powered up. The receiver offers the full suite of high-end Dolby headphone audio processing, as well as a handy feature that can automatically balance game audio and voice chat volume. The various configuration options that you can fiddle with on the receiver can also be changed remotely, using a click-wheel on the side of the headset—a very handy feature that we'd like to see more sets adopt.

The other main function of the receiver is to charge the H Wireless's two swappable lithium ion batteries. Unlike many wireless sets, which have to be plugged into a USB cable to recharge, the H Wireless has an actual removable battery pack, accessed by lightly twisting the plastic cover on one of the earcups. Because the set comes with two batteries, you never have to worry about running out of juice and having to plug in mid-game.

In terms of sound quality, the H Wireless offers what you'd expect from a crazy-expensive gaming headset. It sounds just about as good as any gaming set we've ever tried, with exceptional clarity, sound separation, and good bass response. Like a lot of wireless headsets, the overall volume level is a tiny bit lower than optimal, but it still delivers plenty of power for an immersive experience in games and movies.

The H Wireless sounds great when listening to music as well, though the usual caveat applies: If music is your main priority, you can get a better pair of headphones in this price range if you look at the audiophile market instead of the gaming one.

All in all, the H Wireless is an incredibly solid gaming headset, with a lot of great features and no major drawbacks. It works with game consoles, as well, so you can use it for all the gaming you do in your house. The only real problem is that it's just so expensive. At $300, this set is a full $100 more expensive than a lot of really, really nice cans. If you're thinking about dropping that much money on a headset, we wouldn't discourage you—just make sure that you actually need everything that the Wireless H offers. **–ALEX CASTLE**

VERDICT **9**

Steelseries H Wireless

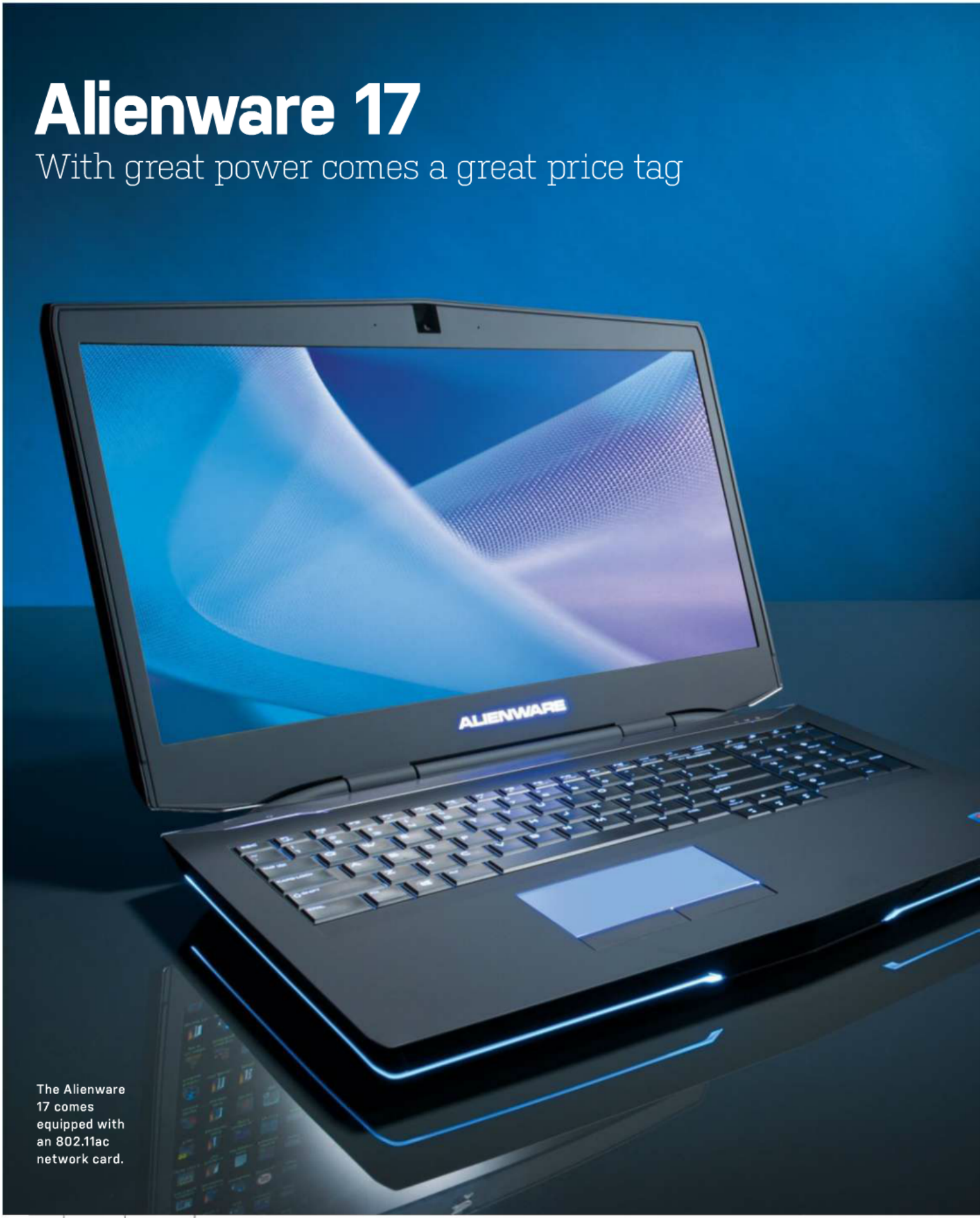
TIRELESS Good build quality; plenty of features; works with consoles; comes with two batteries; looks great.

TIRESOME So, so expensive; volume could be a little louder.

$300, www.steelseries.com

Alienware 17

With great power comes a great price tag



The Alienware 17 comes equipped with an 802.11ac network card.

THIS DESKTOP REPLACEMENT of a gaming notebook might look familiar to you if you've read our January 2014 issue. It does, after all, use the same 16.2x11.7x1.9-inch chassis as the older Alienware 17 we reviewed back then, and this version also weighs over 11 pounds. But while it may look the same as its predecessor, it's been updated with some very key components that make it stand out.

Its most notable upgrade is its graphics card. Now sporting Nvidia's new flagship GeForce GTX 880M GPU, like the Asus RoG Nomad we reviewed in the June issue, this video card packs a 954MHz graphics clock and a 1,250MHz memory clock. One difference that separates Alienware 17's 880M to the Nomad's equivalent is that it has 8GB of GDDR5 memory, twice that of Asus' GPU. Alienware said it chose to go with more memory so that in-game textures would load faster.

Despite the larger frame buffer, the Alienware 17 performed roughly 2 percent to 5 percent slower in our GPU benchmarks. It did still manage to kick the crap out of our zero-point, however, which happens to be its smaller Alienware 14 sibling. In our graphics benchmarks, our ZP gaming notebook lost by an ugly 96 percent to 122 percent. It was like bringing a knife to a gunfight.

Equally formidable is the Alienware 17's CPU. Housing Intel's new mobile 2.9GHz Core i7-4910MQ quad-core, this Haswell chip has some serious chops and can Turbo Boost up to 3.9GHz. It performed 13 percent to 16 percent faster in our CPU tests, which are good gains for what is essentially just a CPU refresh. Rounding out the package is a 256GB mSATA SSD coupled with a 1TB 5,400rpm hard drive and 16GB of low-voltage DDR3/1600. Despite the low-voltage RAM, however, the Alienware 17 wasn't power-efficient enough to last as long as its older 14-inch counterpart. It should, however, have enough juice to play movies over 3.5 hours long.

The rest of the nuts and bolts we've seen before. The Alienware 17 still carries all the fancy lights of its predecessor with its crazy AlienFX lighting system, which Alienware says has over 10 trillion lighting combinations across its 10 programmable color zones. Furthermore, the chassis maintains its signature futuristic sci-fi look with its anodized aluminum LCD cover and magnesium alloy base. The good thing about keeping the same chassis is that the notebook maintains its excellent build quality. There is no flexing here. Another design element that we appreciated is the venting setup, with the exhausts located behind the laptop. Many notebooks vent hot air towards the side, which can play hell on your forearms. Unfortunately, the Alienware 17's fans do rev up quite a bit under load, so it isn't as silent as Asus' Nomad (which is creepily quiet).

The keyboard was less troublesome and maintains the notebook's great build quality by sitting atop a reinforced aluminum plate, which provides a solid typing experience and also prevents crumbs from falling into the notebook's innards. One thing we didn't like so much about the typing experience has to do with the laptop's height. Since it's such a fat chassis, the keyboard is elevated over one inch off the table, which forces your forearms to dig into the front of the chassis. This can be uncomfortable during extended play sessions.

Unlike the Alienware 14, the Alienware 17 does not sport an IPS panel, but rather opts for a TN display. Luckily, it's one of the better TN solutions we've seen. Coupled with its anti-glare finish, the monitor offers excellent viewing angles. Still, considering our build cost a whopping $3,400, there's really no excuse for not including an IPS panel. For that much money, we want the more accurate colors. In addition, in an era of super-high-res laptops, it's a little disappointing that this super-expensive notebook is still sticking with 1080P.

The Alienware 17 is a good laptop, but it's overpriced. The 17-inch Asus RoG Nomad we reviewed in the June issue offers comparable performance, double the SSD capacity, more RAM, is quieter, and cheaper to boot. Unless you care deeply about Alienware's unique LED system and need an 802.11ac network card, we suggest going with Asus's equivalent.

–JIMMY THANG

SPECIFICATIONS

CPU	Intel 2.9GHz Core i7-4910MQ
RAM	16GB DDR3L/1600
Chipset	Intel HM87
GPU	Nvidia GeForce GTX 880M w/8GB of GDDR5
Display	17.3-inch, 1920x1080 TN display (matte)
Storage	1TB HDD (5,400rpm), 256GB SSD
Connectivity	Ethernet, HDMI, media card reader, Mini DisplayPort, 4x USB 3.0, mic input, headphone input, mic/headphone combo input, 2MP webcam, Bluetooth 4.0, 802.11ac, Bluray writer
Lap/Carry	9 lbs, 5.8 oz/ 11 lbs, 7.4 oz

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	962	846
Proshow Producer 5 (sec)	1,629	1,399
x264 HD 5.0 (fps)	13.5	15.5
Bioshock Infinite (fps)	36.1	80.4 (118.7%)
Metro Last Light (fps)	30.4	65 (113.8%)
3DMark 11 Perf	4,170	8,197
Battery Life (min)	234.0	205 (-12.4%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5,400rpm HDD, a GeForce GTX 765M, and Windows 7 Home Premium 64-bit. BioShock Infinite tested at 1920x1080 at Ultra DX11 settings; Metro Last Light tested at 1920x1080 at DX11 medium quality settings with PhysX disabled.

VERDICT 8

Alienware 17

+ ALIENWARE 802.11ac; great speakers; blazing-fast CPU; powerful GPU; competent trackpad.

– FARBERWARE Overpriced; 1080p TN panel; gets loud; big and heavy.

$3,400, www.alienware.com

At 5.5 inches in height, small-form-factor builders should check their case dimensions before snagging this card.

Asus ROG Matrix Platinum Radeon R9 290X

If you've got it, flaunt it

IN THE WORLD of video cards, we generally have three tiers of design. There's the stock or "reference" version from AMD or Nvidia, the cards with proprietary cooling, and finally the cards with both special cooling and even redesigned circuitry on the board itself. The Republic of Gamers (ROG) line from Asus has long been reserved for the company's most premium products, with ROG video cards getting a "Matrix Platinum" tag to further distinguish them.

A certain degree of the difference will be pure marketing, no matter which company you're talking about, but Asus does some indisputably meaningful things to its ROG cards. In the case of the 290X, they give it a cooling system that extends the length of the card (11 inches for stock; 11.5 inches for the Matrix Platinum). There's also a black metal backplate, though the plastic-ness of the fan shroud is a bit of a puzzle at this price. And they made it about 5.5 inches tall, versus 3.75 inches. It's a big boost in surface area, to allow for larger heatsinks and fans. Unlike the Sapphire Vapor-X 290 OC that we reviewed last month, this ROG Matrix card isn't extra-wide, so you can place a second card right next to it—just barely.

The extra size of Asus's card is also to make room for additional voltage-regulator modules, or VRMs. It has a whopping 14 of them. Not all VRMs are made equal, but we have experience with the company's Super Alloy Power (SAP) modules, and spreading power through 14 channels allows each VRM to run cooler, potentially increasing its lifespan. Since the card is wired for up to 75 more watts than the reference model (based on it using two 8-pin PCI Express cables instead of one 6-pin and one 8-pin), more channels are welcome.

And we see the results borne out across the board. Out of the box, the ROG Matrix card does not meaningfully outperform the stock version—when it comes to frame rate. But Asus has an immediate advantage in the noise department. AMD's stock 290 and 290X were notoriously loud, and the GPU ran at up to 94 degrees Celsius. But the Matrix 290X never rises above a gentle hum, and we didn't see it exceed 85 degrees at its default settings.

Additionally, this card has some the most extensive tweaking options we've seen. Usually, you're limited to overclocking the GPU and the RAM, and maybe increasing the "power target," which determines the maximum wattage given to the card. But with this ROG Matrix card, you also get access to GPU voltage, VDDCI (which affects mostly the shader cores), VRAM voltage, and VRM clock. Freshly installed, the GPU runs at 1,050MHz, compared to a maximum of 1,000MHz on the stock model. Armed with our tweakage, we were able to hit 1,100MHz.

Here, we cracked the 10,000-point barrier in 3DMark's Firestorm test—territory customarily reserved for Nvidia's GTX 780 Ti, which retails at $700 on up. The ROG Matrix also beat it in *Tomb Raider*, though it still felt short in *Batman: Arkham Origins*, which tends to favor Nvidia cards. As this issue went to press, the MSRP was hovering around $630, but Asus hoped to bring that down to $600 by the time it shipped, which would put it level with the company's more mainstream "DirectCU II" model. This is about $100 more than a GTX 780, but this is the first time that we've gotten a stable 290 or 290X overclock this high.

–TOM MCNAMARA

VERDICT 9

ASUS ROG MATRIX PLATINUM

KRUSTY THE CLOWN Quiet; highly tweakable; respectable overclocks.

RONALD MCDONALD Pricey; plastic fan shroud.

$630 (street), http://rog.asus.com

BENCHMARKS 2.4GHz 802.11n / 5GHz 802.11ac

	ASUS ROG Matrix Radeon R9 290X	Sapphire R9 290 Vapor-X OC	Gigabyte Radeon R9 290X	Gigabyte GTX 780 GHz Edition	GTX 780 Ti Reference
Driver	14.4	14.4 beta 1	13.12	331.80	337.50
3DMark Fire Strike	9,860	9,602	9,837	9,695	**9,976**
Unigine Heaven 4.0 (fps)	35	33	34	**39**	**39**
Unigine Valley 1.0 (fps)	42	39	41	48	**48**
Call of Duty: Ghosts (fps)	48	46	48	**53**	52
Crysis 3 (fps)	29	29	**31**	30	30
Tomb Raider (fps)	**27**	25	26	25	26
Metro: Last Light (fps)	30	29	30	25	**32**
Battlefield 4 (fps)	48	46	47	45	**52**
Batman: Arkham Origins (fps)	74	72	65	51	**78**
Assassin's Creed: Black Flag (fps)	30	28	30	30	30
Price (street)	$630	$500	$550	$520	$700

Best scores are bolded. Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an Asus Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8.1. All games are run at 2560x1600 with 4x MSAA, except for 3DMark.

Enermax Liqtech 240

An industry veteran gets loopy

IF THERE'S anything we've learned about hardware companies over the years, it's that diversity is the key to survival, much like life in the jungle. For companies like Enermax, that seems to mean branching out beyond the power supplies and case fans that it's built a reputation on. In recent years, the company has expanded into the CPU-cooling sector, and the Liqtech 240 is its latest new hotness. But we'll tell you right off the bat that this 240mm closed-loop liquid cooler is not a mold-breaker. Then again, a company doesn't need to re-invent the wheel to be successful.

One major element we look for in a CLC is ease of installation. The Liqtech 240's heatsink's Intel brackets were already installed, so that saved us a step. For our LGA 2011 motherboard, we just had to insert a set of bundled screws into its backplate, apply some thermal paste on the CPU, and secure the heatsink on top of the CPU with a set of bundled nuts. (The radiator attaches to the case with another set of bundled screws.) The bracket nuts have integrated springs that are a bit stiff, so we needed a screwdriver to provide enough force, a hand to hold the nut, and another hand to hold down the heatsink. That's not great math for one person, so it took a little trial-and-error before we were able to fasten a few of the nuts. Not a deal breaker, but we've seen better implementations.

The radiator fans have a switch on them with three settings for fan speeds. We used the highest setting, allowing fans to range from 500rpm to 2,500rpm based on PWM instructions being sent by the motherboard. Interestingly, this is a whopping 700rpm higher than the version of the fan sold at retail, and the blades are solid black instead of translucent. Unfortunately, the switch is impossible to reach once the fan is installed, so you'd better choose wisely. On the bright side, the fan cables have a high-quality braid and attach to a braided and bundled Y-adapter, so that they can be controlled by a single 4-pin header. Also, the radiator has pre-installed silicone strips that act as gaskets to absorb vibration and thereby reduce noise. The CLC's tubing is on the stiff side, but that's a trade-off made to reduce evaporation of the coolant inside. It's clear that a lot of thought has gone into the Liqtech, from design to build quality. All that's left now is performance.

The Liqtech's fans idled at a much lower speed than we usually see—about 550rpm. This is going to make the CPU run a little warmer when there isn't a load, but a few degrees Celsius in this range doesn't make much difference to the life of the chip. What matters is how well the cooler works under load when compared to ambient room temperature, and the Liqtech 240 passed that test with flying colors. With the fans set to "quiet," its load performance is less than 1 C warmer than the Corsair H100i, which is arguably the bar-setter at the 240mm tier. That's practically within the margin of error, and an excellent showing.

We give more weight here than with the "performance" setting, which is customarily too loud to deal with for an extended period of time anyway. The Cooler Master Nepton 280L has the best CLC performance that we've seen so far, with the only caveats being the poorly placed fan switch and its 280mm radiator won't fit in a number of cases. For its size, Enermax's Liqtech 240 is no slouch.

–TOM MCNAMARA

BENCHMARKS

	Enermax Liqtech 240 Quiet / Performance Mode	Corsair H100i Quiet / Performance Mode	Cooler Master Nepton 280L Quiet / Performance Mode	Cooler Master 212 EVO Quiet / Performance Mode
Ambient Air	22 / 21.7	20.3 / 20.5	22.1 / 22.4	20.5 / 20.3
Idle Temperature	36.3 / 30	30.7 / 29.3	33.2 / 30	35.5 / 30.5
Load Temperature	69.7 / 66.3	67.1 / 61	64.5 / 63.3	70 / 67.3
Load - Ambient	47.7 / 44.6	46.8 / 40.5	42.4 / 40.9	49.5 / 47
Price	$110	$95	$120	$35

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard in a Corsair 900D with stock fans set to Standard.

VERDICT 9

Enermax Liqtech 240

ROCKY ROAD ICE CREAM Excellent performance; clean cabling; high-quality materials.

ROCKY MOUNTAIN FEVER Somewhat tricky install; fan switch needs better location.

$110 (street), www.enermaxusa.com

SPECIFICATIONS

Radiator Dimensions (H x D x W)	1.07 x 10.75 x 4.7 inches
Weight	3.1 lbs
Stock Fans	2x 12cm PWM
Socket Support	LGA 775/ 1150/ 1155/ 1156/ 1366/ 2011; AM2/ AM2+/ AM3/ AM3+/ FM1/ FM2/ FM2+
Additional Fan Support	2x 12cm

This cooler uses the company's new "Twister Pressure" fans, purportedly an upgrade from its older T.B.Silence units.

Future

gamesradar.

take this, it's dangerous to go alone

www.gamesradar.com

The K830 is good but suffers from mushy-key syndrome.

Logitech K830

A premium HTPC keyboard with backlighting

PEOPLE DON'T JUST buy desktop keyboards: they have long-term monogamous relationships with them that last for years. Hell, some editors we know just celebrated their fifth-year anniversary with their desktop keyboard (the traditional gift is wood, by the way).

It's not that way with HTPC keyboards, though. No, HTPC keyboards are more like those "business" trips to Thailand. Just look at us for example: Over the last few years, we've not only stepped out with an assortment of no-name Bluetooth keyboards, we've also had flings with Logitech's DiNovo Edge, DiNovo Mini, the K400, and even the K700 from Google and Logitech's ill-fated Google TV product.

The latest so, so pretty keyboard to catch our eye is Logitech's K830. And what a beauty she is. Slightly wider than the K400 at 14.5-inches, the K830 has a feeling of heft and quality that the budget K400 lacks. The sexiest aspect of the K830 is its subtle white LED backlighting. The lighting has four settings: off, low, medium, and high, and once switched on, the volume and mute buttons also light up. Logitech did the right thing by also illuminating all the characters of the keyboard. A lot of far more expensive gaming keyboards fail to do this, forcing you to guess which shifted keys to press for $#%^, among others.

Also much improved is the trackpad, which has a luxuriously smooth surface and is slightly larger than the K400's. Although we will say that if Logitech had pushed the trackpad further into the corner of the keyboard, it would be easier to use the trackpad one-handed, as with the K700. However, in all honesty, the K830 is also a little too heavy to one-hand it for long sessions.

With the power consumption of the LED, the possibility of running off of AAA alkalines is out—instead, Logitech uses a lithium ion, which charges through micro-USB. Logitech says that gives the K830 about ten days of runtime. That's pretty poor when you consider that the K400 is rated to run for 12 months off of a pair of AAA's. Realistically, though, you're not going to be using the keyboard to type for ten days straight, so we'd expect more along the lines of a month or more, depending on the back-light levels.

That brings us to the biggest ding against the K830—the actual keys. While the keyboard looks drop-dead sexy next to the K400 and K700, the keys are down-right mushy and just no fun to type on. Yes, you typically won't be typing more than "Maximum PC No BS podcast" in the search bar of YouTube, but it's a bit of a heart-breaker that the K830's key action is its worst aspect. If you're looking for hot keyboard action for typing-heavy duties, we'd recommend scrounging up an old K700, honestly. We will laud one thing Logitech did, though: The function keys have dedicated functions for such things as launching the browser and search rather than the function + F8 you'd typically find.

One other thing to note, the K830 uses Logitech's Unify USB dongle to connect to devices. Unify lets you run multiple devices simultaneously, which is great. What's not great are so-called "smart" televisions that don't support standard USB HID devices. We tried, for example, to connect the K830 to a new Sony 65-inch Bravia 65W850A and had no joy despite the three USB ports on the set. So, if you intend to use the keyboard with your "smart" TV, we recommend you read the manual first.

The last hang-up is the price. At $100, the K830 is far more expensive than its current siblings. But we will say one thing, it certainly looks better and feels better than them, too. It's also not that expensive when compared to the Dinovo Edge, which sold for $200 when new. Still, it's not perfect. If Logitech could just combine the keys of the K700, move the trackpad a little farther into the corner, and shed a few grams, this could be the ultimate HTPC keyboard. As is, it's good but not great.

–GORDON MAH UNG

VERDICT **8**

Logitech K830

BANGKOK Luxurious trackpad; pleasant backlighting.

DHAKA Mushy keys, slightly heavy.

$100, www.logitech.com

Theocrat

We must help break the siege at Troy.

Age of Mythology: Extended Edition

Prettier, sure, but not for its price

AH, REVAMPS. Ah, *Age of Empires*. We can remember, with much fondness, the rise of Ensemble Studios' great entry into the real-time strategy world of the 1990s. In an era otherwise dominated by the RTS heavyweights—*Command and Conquer*, *Warcraft II*, and eventually *Starcraft*—*Age of Empires* offered up a unique, resource-driven spin on the typical rush-or-turtle gameplay of its peers.

The look and feel of Age of Empires was quite a bit different than what was being offered elsewhere, including its "upgrade through epochs" style of gameplay, the game's huge number of civilizations one could pick to play as (all with unique bonuses and technologies of their own), and the introduction of game-ending "Wonder" buildings that one could create—warning all playing that they better come stomp you quickly before the building timer counted down.

Capitalizing on the popularity of the *Age of Empires* series at the time, Ensemble Studios opted to release the spin-off title *Age of Mythology* in 2002. We're not quite sure why *Age of Mythology: Extended Edition* has been revisited by the company some 12 years after the initial release of the game, but we do applaud Ensemble Studio's efforts at keeping classic games relevant. We just wish that they did a bit more for this second go-around.

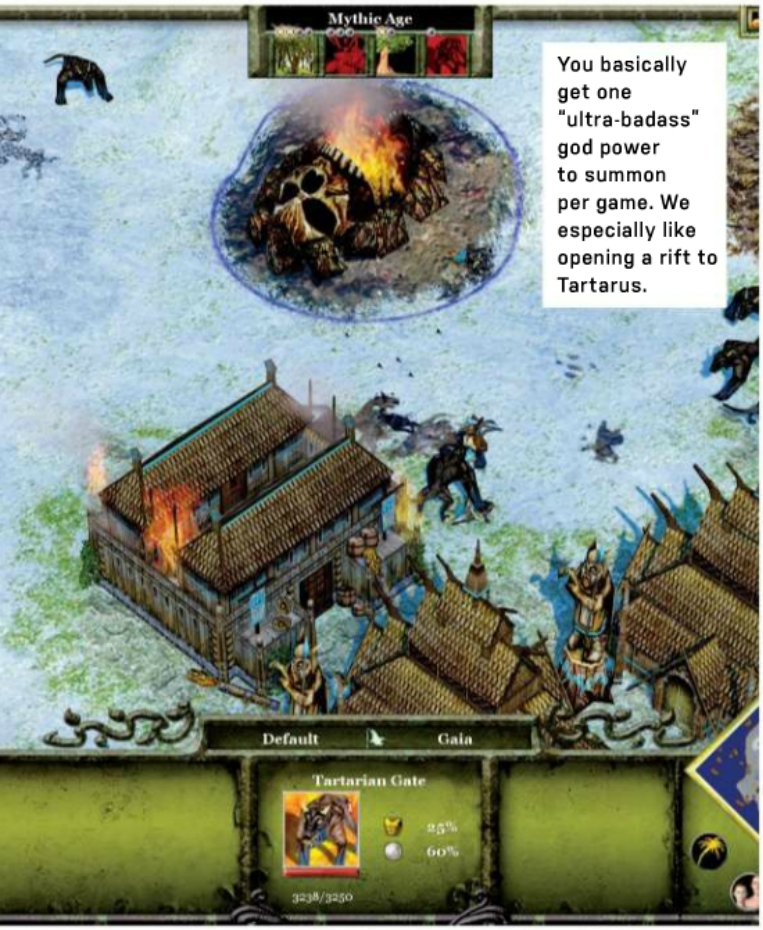
That's not to say that *Age of Mythology: Extended Edition* is a picture-perfect recreation of its predecessor. There are actually quite a few improvements designed to make the game more relevant for today's times. Twitch is integrated directly into the game itself, should you be of the broadcast-your-base variety, as is Steamworks. Mods can be quickly found via Steam Workshop and downloaded directly into the game, multiplayer matchmaking is tied directly into Steam itself, and all the other fun Steam features—badges, clod saves, achievements, trading cards, etc.—join the party, as well.

Ensemble Studios has also thrown in a few graphical updates, bringing a day/night rotating cycle into one's skirmishes, as well as upgrades to the game's water, shadows, lighting, and antialiasing (to name a few). We confess; we didn't go back and fire up the 2002 version of the title to see just how everything has changed (nor do we think we could likely even get it to play nicely with today's Windows 8 operating system). And since a GoG.com doesn't have a version of the game—for those unaware, that's a website that sells retro games redesigned to work with today's operating systems sans hassle—we don't really have a basis of comparison for the visual tweaks Ensemble Studios has made.

What we can report, however, is that even with all of these upgrades, *Age of Mythology: Extended Edition*, still very much feels like a 12-year-old title. The game's single-player mode, split into three distinct campaigns, comes with plenty of missions to play. However, they isn't really anything that greatly moves us given the confines of the game's engine—perhaps creative back in 2002, but a bit dated for today.

The game-engine-driven cutscenes look horrible. In-game units don't look bad per se, but they do look blocky and artificial. Even with the alleged improvements to the game's shadows, units and buildings still looks like sprites that have been crudely pasted onto lower-quality backgrounds. The new water effects look a bit more natural but, in general, it's hard for *Age of Mythology: Extended Edition* to ignore its age. Even the UI buttons and icons look pixilated, which, to us, seems like a pretty easy area to tweak.

Navigating through the UI, especially to trigger various combat options for your armies, is every bit as annoying as it was the last time we played this title. On top of that, there are some critical RTS problems



You basically get one "ultra-badass" god power to summon per game. We especially like opening a rift to Tartarus.

In typical *Age of Mythology* fashion, you can upgrade the heck out of just about everything.

we wished that this upgraded version would address. For example, we find it troublesome that you're limited in the number of total units you can assign to a hotkey; we're pretty sure that limitation went away within the genre years ago.

As for the gameplay, it's the same ol', same ol' as that which you may have played a decade ago. In a conventional single-player matchup, you're using your resource-generators (villagers) to give you food, wood, gold, and "favor," the latter being the means by which you conscript more powerful mythological elements into your armies via your local temple.

In typical *Age of Mythology* style, you have to balance what your villagers produce against the need to build more houses to support your armies, against the need to perform all kinds of upgrades to make your fighting force more formidable. You're also doing your best to scout out the enemy army so you can better align the game's rock-paper-scissors tactics in your favor. If you're playing against a big cavalry nut, for example, it'll be worth your while to max out on the units that excel against horsies.

Also thrown into the mix is an intriguing upgrade path for your civilization—a staple of the franchise that, in this case, asks you to pick the allegiance of one of two gods each time your civilization advances to a new age. Each god, as you might expect, comes with its own unique bonuses and powers to benefit your economy and/or warmongering. Eventually, you'll reach enough upgrades to grant you the ability to construct the ol' game-winning "wonder" building for your race or, if you're feeling feisty, you'll be able to "find" a giant Titan that will kick all sorts of ass on your foes.

We're a bit bummed that the game's other deity-driven feature feels a bit stymied. Your limited to the number of times you can use up to four, specialized "god powers" in each game; that doesn't feel very godlike to us, though we somewhat respect wanting to keep *Age of Mythology* a bit more balanced and/or less insane.

While we find the core game interesting, we also found ourselves getting a bit bored by the same kind of gameplay that we've already devoted plenty of time to—the curse of publishing classic games in the modern day, we suppose. That said, there's enough retro pleasantry to make *Age of Mythology: Extended Edition* worth its asking price were publisher Microsoft Game Studios to slap a $10 tag on it and call it a day. At $30, Microsoft's game plan is downright insane; we didn't feel as if we got $30 worth of value out of what amounts to a buffed version of a classic.

Unless you've been pining away for a more compatible, Steam-friendly version of *Age of Mythology* for years now, we recommend you wait for the next, greatest Steam sale before plunking down on this digital-only title. This is a modern-day refresh, not a modern-day remake. One of these is worth much more than the other, but that's not what you're getting here.–
DAVID MURPHY

VERDICT 5

Age of Mythology: Extended Edition

IMMORTALS Fairly thoughtful, rock-paper-scissors gameplay; novel mythological tweaks to standard Age of Mythology gameplay; excellent Steam integration.

CLASH OF THE TITANS (2010) Aged title suffers in graphical quality and usability; campaigns feel boring and underwhelming; way too expensive for what it's offering.

$30 digital, www.ageofempires.com/AoM.aspx, ESRB: T

Linksys WRT1900AC

Crowning a new king

DON'T BE FOOLED by the old-school styling of the Linksys WRT1900AC—it may look like a blast from the ancient past, but it schools the modern competition, including our previous favorite AC router, the Asus RT-AC66U. The new Linksys model is faster, easier to set up, and has more ports to play with.

In regard to the physical design, Belkin, which owns the Linksys brand, intentionally modeled the WRT1900AC after the WRT54G, supposedly the best-selling wireless router model of all time. The WRT1900AC is similarly shaped, with a familiar blue-and-black color scheme, but noticeably larger and with twice as many antennas protruding out (four versus two). They're removable/upgradeable and configured in a 3x3 array, meaning it supports three spatial streams in each direction. Linksys also baked in beamforming support, which allows the router to concentrate its signal on active clients for a more reliable connection.

Belkin took a risk by going the retro route—true geeks with fond memories of the WRT54G are likely to wet their pants with excitement over the return of an iconic design, whereas everyone else may have a tough time accepting the attention-grabbing aesthetic. Those who bypass the WRT1900AC based on looks will be doing themselves a disservice, though, because there's not a faster consumer model on the market. As indicated by the model name, this is a Wireless-AC unit. It's rated for up to 600Mb/s on the 2.4GHz band in 802.11n mode, and up to 1,300Mb/s on the 5.4GHz band in 802.11ac mode. You can't add these signals together for a super-connection of sorts, however, even though router makers love to advertise the combined theoretical throughput.

Linksys outpaced the Asus RT-N66U in almost every speed test, including a clean sweep on the 2.4GHz band in 802.11n mode. When we switched our focus to the 5GHz band and 802.11ac performance, the WRT1900AC ran nearly 14 percent faster at close range and almost 19 percent quicker in our Dining Room test, which is farther away and separated by a wall. Asus went down swinging and took two of the five 802.11ac tests, including a victory in the long-range Backyard run, though we suspect it was automatically switching to 802.11n mode at that distance.

Wired and physical connectivity options consist of four Gigabit LAN ports, a USB 3.0 port, and an eSATA/USB 2.0 combo port, all of which are found on the back of the router. File transfers over USB 3.0 are blazing fast—it took just over 33 seconds to transfer a 3GB file from a Lexar JumpDrive P10 flash drive plugged into the router's USB 3.0 port to our test PC, and 40 seconds to fling the same file in the opposite direction.

Linksys bills the WRT1900AC as a "Smart Wi-Fi" router. Setup is super easy, and once you're up and running, you can use the router's smart capabilities to log in remotely from a browser on a connected device or via an Android or iOS app. This is particularly handy when tapping into the new Network Map, which provides a visual of all devices connected to your network. Between the two, you can monitor your home network when you're away, and if necessary, set parental controls if little Billy's Xbox usage is keeping him up later than promised.

Speaking of which, it took some finagling with Port Triggering settings in order to access Xbox Live and watch streaming video from Hulu and Netflix without hiccups. We didn't have this problem on the RT-N66U, but if you run into trouble, the proper port-triggering settings are easily found on the web.

While setup is quick and easy, there's not a ton of low-level control compared to other high-end AC routers we've tested, at least not out of the box (the WRT1900AC is compatible with open-source firmware). We're also put off by how Linksys handles guest accounts. You can only choose a single password for both the 802.11n and 802.11ac guest bands, and users who hop on will have to enter that password in a web browser every time they initiate a new connection, even if they've saved the connection. Since it's advisable to use a strong password, this means you'll be inputting it for them each time they come over, unless they're able to memorize your alphanumeric combination.

Our minor gripes are hardly reason to turn down this router, though the price tag will scare some folks away. At $280 MSRP, it's not cheap. However, the WRT1900AC is easily the best router currently available. –PAUL LILLY

BENCHMARKS 2.4GHz 802.11n / 5GHz 802.11ac

	Linksys 802.11n (2.4GHz)	Asus 802.11n (2.4GHz)	Linksys 802.11ac (5GHz)	Asus 802.11ac (5GHz)
Bedroom – 10ft (Mb/s)	**182**	170	**466**	410
Dining Room – 15ft, 2 walls (Mb/s)	**152**	121	**310**	261
Entryway – 20ft, 3 walls (Mb/s)	**149**	114	233	**242**
Driveway – 35ft (Mb/s)	**98.2**	96.3	**169**	160
Backyard – 90ft (Mb/s)	**28.1**	13.5	16.5	**22.1**

For information on how we test routers, check out http://bit.ly/MPC_Routers2014.

VERDICT 9 KICK ASS!

Linksys WRT1900AC

ADAM SILVER Wicked-fast performance; throwback design (if you're into it); open-source support.

DONALD STERLING Weird guest account implementation; takes some fiddling to work with Xbox Live; throwback design (if you're not into it).

$280, www.linksys.com

BENCHMARKS File Transfers

	Linksys WRT1900AC	Asus RT-AC66U
3GB Router to PC (min:sec)	**0:33**	5:31
1GB Router to PC (min:sec)	**0:15**	1:51
3GB PC to Router (min:sec)	**0:40**	11:59
1GB PC to Router (min:sec)	**0:27**	3:35

The WRT1900AC's design is a throwback to the 12-year-old WRT54G, the best-selling router of all time.

B.J. can dual-wield a variety of weapons, almost all of which have an alt-fire mode.

Wolfenstein: The New Order

We did Nazi it coming

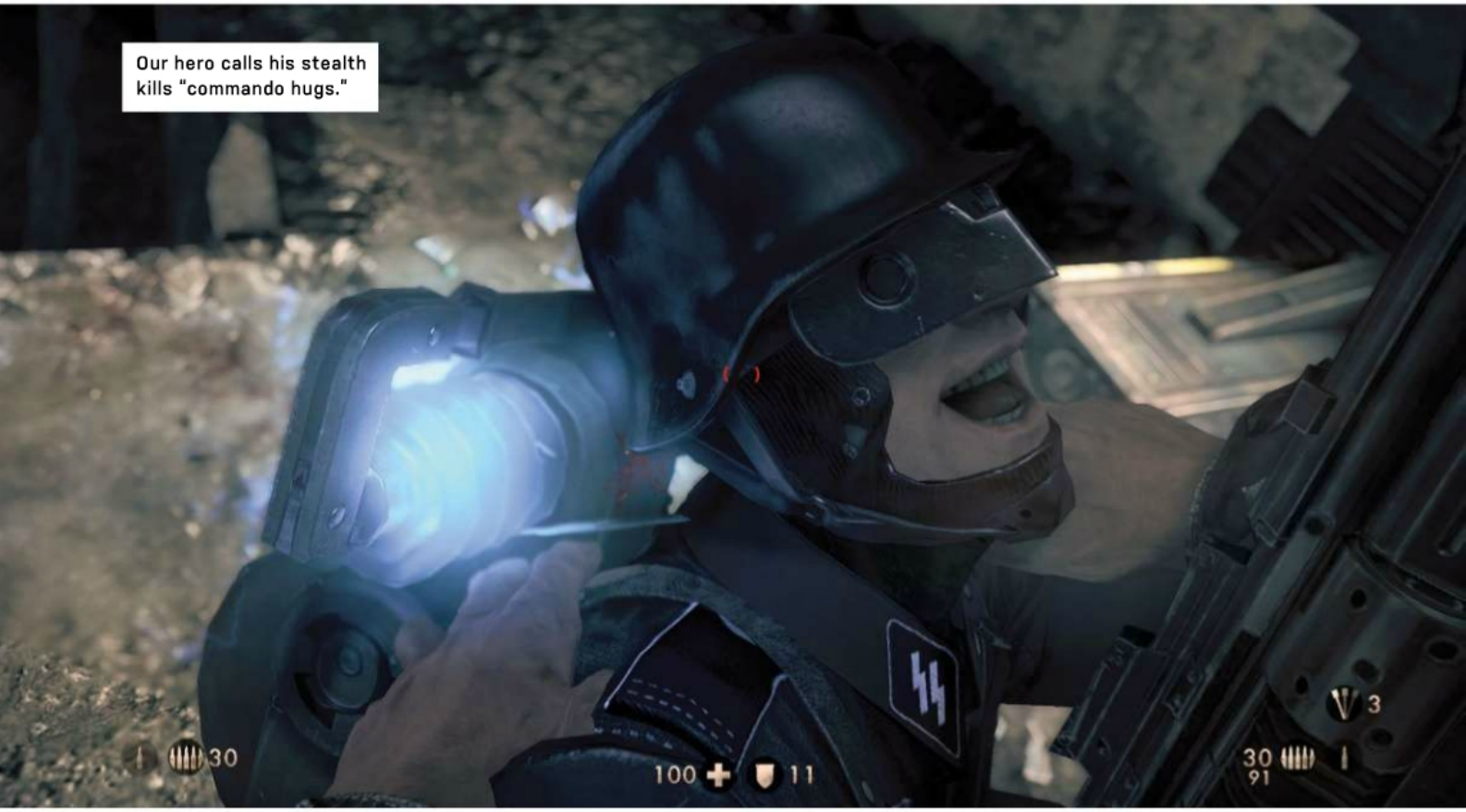
GAMERS MAY argue over who was the first to do a 3D first-person shooter, but no one denies that *Wolfenstein 3D* was a historic experience. Made back in 1992 by a little company called Id Software, it set the tone of the FPS for years to come and can still be purchased today. But in the time since, the rest of the industry has caught up and passed it in nearly every way. To do an FPS now means competing against multi-billion dollar companies using hundreds of people working around the world. So, how does *Wolfenstein 3D*'s legacy survive into the modern era?

They've already tried twice now, with *Return to Castle Wolfenstein* in 2002 and *Wolfenstein* in 2009, the latter of which the franchise's current owner Bethesda does not recognize as canon and declines to distribute. This is not a minor issue, since *The New Order* is a direct sequel to 2009's *Wolfenstein* and reintroduces three characters and their back stories. Until Bethesda changes its mind, we're missing a pretty big puzzle piece of a story-driven game.

And it's a pretty good story, too. *The New World* begins in 1946, in an alternate World War II where the Nazis are winning, thanks to inexplicably advanced technology. Part of the game is about figuring out where their edge came from, but the bulk of it is just fighting the global war machine that they have become by 1960. That jump in time is thanks to a certain incident involving our hero B.J Blazkowicz. He eventually returns with a vengeance, though you'll probably be scratching your head over how it was possible, considering the nature of his absence. The game provides no answers.

There are a few Big Dumb Action Movie plot holes like this that are difficult to ignore, given how story-driven the game is. But the characters of *The New Order* are generally well-rounded, with convincing dialog and voice acting. While the 1992 original was a shooting gallery with a general theme, *The New Order* has a cinematic narrative, complete with love interests, plot twists, and dramatic tragedy.

Most of it is played out using in-game cutscenes, but you can also explore the different areas of the game for newspaper clippings, overheard conversations, and other bits that add layers of detail to this eerie and unsettling alternate Earth. This fleshes out the world's alternate history, but it's also that much more jarring when parts of the plot don't neatly intertwine together. Still, the developer provides a better story than we've come to expect from an



Our hero calls his stealth kills "commando hugs."

FPS. MachineGames may be a new name, but many of the team members come from Starbreeze Studios and worked on the *Chronicles of Riddick* games.

As you might expect, then, our friends know a few things about gunplay and explosions. The action, similar to *Riddick*'s, should be familiar to anyone who's picked up a shooter in the last five years, with partially regenerating health, checkpoint saves, health packs, iron sights, and collectibles. MachineGames mixes it up by compelling you to kill a Nazi commander first, who will call in reinforcements until you eliminate him. You can stealth around to a certain degree and take alternate routes for better vantage points. There's a perk system that rewards you with things like extra grenades or faster weapon reload times, tailored to your play style. And there are a few weapon upgrades scattered around, sometimes hidden in secret spots. The scenery and enemy types evolve at a good pace, as well. The firefights feel pretty conventional at first, but there are enough tweaks here to elevate it above mindless shooting.

It would be nice if the enemies were more observant of each other, though. Too often, we were able to dismantle the opposition by sniping the commander with a silenced pistol, before he'd alerted anyone. No one seemed alarmed by his slumping corpse, allowing us to ninja our way from one enemy to another with a mixture of silenced shots and knife kills. (Non-lethal combat is absent, but killing Nazis usually doesn't trigger moral quandaries, anyway.) There's no multiplayer in *The New Order* to balance things out in the enemy-smarts department, but its absence allows the developer to devote more time and energy to the single-player experience.

Also, when the game doesn't give you the option for stealth, it can get really hairy. A few times, you'll be dealing with multiple waves, with no checkpoint in sight. The game doesn't allow quicksaves (it also doesn't use Steam's cloud save system, nor could we detect the location of the save files themselves), so you're at the mercy of MachineGame's difficulty curve, which gets pretty steep in the last act of the story.

Speaking of architecture, *The New Order* is a pretty good-looking game. Textures are detailed, people move and speak convincingly, the color palette is varied, and MachineGames appears to have fun with the world's retro-futuristic technology. Your graphical options aren't explained very well in the settings menu, but you can at least tweak your field of view, which is important for gamers who tend to get nauseated when playing a shooter. Bethesda has strongly recommended a CPU with eight processing threads, but we didn't experience a material difference when we disabled Hyperthreading on our 4770K or 3770K. With a stock GeForce GTX 780 Ti and all game effects maxed out, we got about 55 frames per second in the opening sequence at 2560x1600, regardless of CPU status. You can apparently disable or lower some settings without much visual impact, like shadow resolution and depth-of-field.

Frankly, our expectations for this game were not high. It's pretty rare that new life is breathed into something that's been around for so long. The trailers were long on story but short on action. The studio was new and didn't have much clout, despite the pedigree of some individual members. And we did find a few things in the game that we wish had been done differently. But MachineGames has delivered the best *Wolfenstein* yet, and it's a welcome addition to our shooter library. –TOM MCNAMARA

VERDICT **9**

Wolfenstein: The New Order

BUTTERED POPCORN JELLY BEANS Engaging combat; detailed world; shiny visuals.

BLACK LICORICE Save game issues; a few plot holes.

$60, www.wolfenstein.com

LAB NOTES

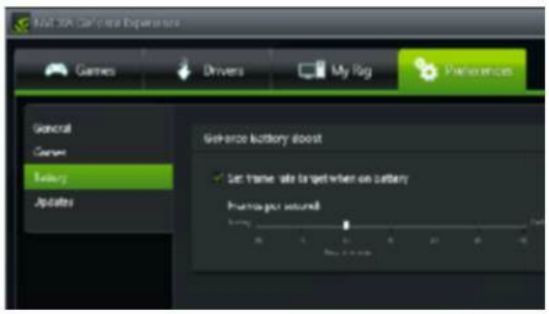
JIMMY THANG **ONLINE MANAGING EDITOR**

Putting Battery Boost to the Test

Unfulfilled potential or over-inflated gobbledygook?

A FEW MONTHS AGO, I sat down with Nvidia for a look at the company's new mobile GeForce Battery Boost feature. The idea behind the feature is that it could potentially double gaming battery life. This sounds promising, given that modern gaming laptops essentially need to be tethered to wall sockets to get enough juice, especially when you consider that gaming drains battery life five times faster than movie watching. So, when the first 800M-equipped notebook (the Asus Rog G750 reviewed in the June 2014 issue) came into our Lab with GeForce Battery Boost, I was stoked to test it out.

I was disappointed to see, however, that Battery Boost only improved longevity by a paltry four minutes. When I asked Nvidia why this was, the green team told me that the G750 wasn't a good example to go by, considering that Asus already heavily throttles its notebooks to optimize for battery life—similar to how Battery Boost handles it. Considering Asus's offering lasted well over an hour for gaming, I didn't mind too much. With that said, I was cautiously optimistic to see how this month's Alienware 17 would fare using the feature. However, this time I saw no battery-life increase from enabling it, and the laptop tapped out after exactly 66 minutes in both modes.



I asked Alienware why this might be the case, and the company wasn't very aware of Nvidia's new battery-saving feature. When I followed up with Nvidia, the company said it wasn't too familiar with how Alienware configured its 17-inch notebook. Nvidia did say that forthcoming notebooks would be better examples of the feature, but until then, it appears that Battery Boost's bark is worse than its byte.

CLARK CRISP

Senior Intern

I started reading *Maximum PC* during the summer of 2012 in a dusty lifeguard shack in the foothills of the Sierra-Nevada Mountains. *Maximum PC* became an escape from my monotonous reality, where I envisioned hexa-core processors and godlike GPUs mighty enough to handle any title thrown their way. During my final year of college, I was brought on to learn from those who had already taught me so much. After nine months, my time as an intern has come to an end. I want to thank all of the editors for their kindness, patience, and for teaching me everything I know about PCs. I guess I should resubscribe soon!

ALAINA YEE

Managing Editor

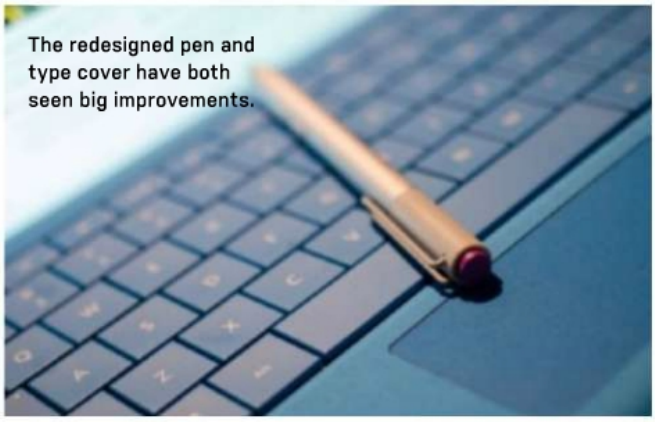
Coming from the console side of gaming, the news about the Steam Machine controller delay has been particularly fascinating to me. Though there've been jokes about how this announcement makes the various Steam Machines that much closer to its competitors, I do wonder if the momentum and enthusiasm behind the concept will begin to flag by the time we reach 2015 (particularly if the delays stretch late into the year). Widespread fan support is so necessary for new consoles to survive; without it, even with superior hardware or features, a fresh contender can die a premature death. (We hardly knew ye, Dreamcast.) I'd hate to see that happen to the Steam Machines.

First Look: Microsoft Surface Pro 3

Hybrid line now aiming to compete with laptops

MICROSOFT HAS BEEN CHASING a dream for the last three years, trying to create a tablet that has all the power of a PC yet portable enough to carry. With its latest Surface tablet, Microsoft is upping the ante with an even larger 12-inch slate over its last couple of 10-inch entries.

While there's an added two inches of screen real estate, the Surface Pro 3 is actually both lighter and thinner than last year's model. When compared to the girthier Surface Pro tablets of yore, the Pro 3 feels like a lightweight. This is largely thanks to Microsoft slimming down its Pro line from 901 grams and 13 millimeters thick down to 800 grams and 9.1 millimeters thick. It's an amazing feat, and the tablet even looks better with it slimmer fan grill. And it's light enough that you can finally hold it with one hand—for a short while, anyway.



The redesigned pen and type cover have both seen big improvements.

The amazingly light build is a pleasant surprise, given its jump to a 12-inch screen. Microsoft not only added two inches to the display, but also bumped up the resolution to 2160x1440 and given it a rare 3:2 aspect ratio—classically used in 35mm photography. The higher-resolution screen makes websites look crisp with sharper text and images. Meanwhile, the display is also higher contrast, for video that pops with vibrant colors and deep blacks.

Hardware-wise, the preview unit Microsoft handed us was equipped with an Intel Core i5-4300U processor with 4GB of RAM and 256GB of storage. With this hardware package, the tablet was quick to open applications and kept up with all of our heavy web browsing in Firefox with more than 15 tabs open at once. There weren't any hints of slowing down, even when we started editing photos in Lightroom in full-screen mode.

The most joyous thing about using the Surface Pro 3 is the accessories, oddly enough. Microsoft has revisited the included Surface Pen, modifying the utility of its "eraser" button on top. Mimicking the action of a spring-loaded ballpoint pen, clicking this button automatically launches OneNote and allows you to start writing instantaneously. Taking handwritten notes is something we hardly ever do with tablets, but the intuitive action and accuracy of the Surface Pen impressed us.

While not included, the new type cover is well worth its $130 price tag. Just below the magnetic connector, the new type cover features another magnetic strip that clips to the bottom lip of the tablet. While it's a small change, it finally makes the keyboard stable enough to use on your lap.

Around the back of the tablet there's also a new friction hinge that does more than lock into two positions, as did the Surface and Surface Pro 2. This new hinge starts from a steep 22-degree angle and rotates all the way to 150 degrees, letting the tablet nearly lounge on a table or your lap. In this "canvas mode," the tablet lays back in a slightly pitched angle—perfect for note-taking or doodling on the Pro 3.

We're really digging the Surface Pro 3 from our short time with it. Microsoft may have finally created a PC you can hold in one hand, but we won't know for sure until we've put it through our benchmark tests. Starting at $800 (or $930 with the pretty-much-necessary type cover) for the lowest-end Core i3 model, Microsoft's latest tablet is still asking a high price when compared to equally equipped ultra-books or, dare we say it, an 11-inch MacBook Air that comes with a 1.4GHz dual-core Intel Core i5 chip standard. For the model we received, Microsoft is asking an even steeper $1,300. But on the surface (ha!), the Pro 3 has a few things going for it, including the gorgeous screen and solid magnesium body. We'll find out just how well it stacks up against its competition next month—tune in for our review! **–KL**

GEEK TESTED & APPROVED

Plantronics Voyager Edge

WHILE IT MAY SEEM like a minor offense, getting a ticket for talking on your phone while driving can cost you a hefty sum. Plantronics is trying to solve this problem with its best Bluetooth headset to date, the Voyager Edge.

The Edge is light and small, weighing 0.4 ounce and measuring roughly two inches long. It comes in three different colors: black, grey, or white, and its aesthetics are sleek, with a sci-fi edge.

Voice commands work very well; the Edge supports both Siri and Google Voice. On our Nexus 5, calling someone was as easy as saying, "OK, Google" followed by "call [name]." In addition, for incoming calls, the Edge tells you who's calling; you accept or deny by simply saying "answer" or "ignore."

The Edge will last you about six hours of talk time on a single charge. While that may seem short, Plantronics has included a small mini-USB charging dock that can provide an additional 10 hours of talk time.

The Edge pops in the ear just like any other earbud, but the headset's biggest problem is that it's a bit too big for small ear canals. Luckily, it also comes with an over-the-ear attachment.

That quibble aside, the Edge does everything else well and gets our geek seal of approval. **–JT**

$130, http://bit.ly/MPC_voy

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Reader Rebuttal
> Taming of the Cables
> How CPUs and GPUs Think

Reality Check

I think reader George Kapalka ("How Much Is Microsoft Paying You?", June 2014) needs to dive into the *MPC* archives for a refresher on how Microsoft has done things since the beginning of Windows. MS tends to try major changes that come before hardware is really in place to take advantage of it. Occasionally, they knock one out of the park like Windows 3.1 or XP, but more often we see a Windows Vista– or 8–type debacle. Neither are bad OSes, but Vista needed more RAM to be viable compared to the average of 1GB RAM in the machines of the period, while Windows 8 touch capability came before touchscreens were standard on most PCs.

Truth is, both OSes had plenty of innovative and new features, but bad marketing (Microsoft's bane for a long time) and poor media response didn't help. There was a lot of crying over Windows 95 when it first released, and I'm sure many wish ME had never been created. The reality is Windows 8 is a better OS than Windows 7, and while the Modern interface may not be a big success, that's more due to poor marketing and development decisions than a poor UI. If Microsoft had made the UI more capable on faster machines, maybe people would have been more interested in using it. The show isn't over yet, though, as the future isn't written in stone and the new Windows tablets may promote more development and usage. Enough so that in a year's time, it may put Windows 8 on the mobile map enough to give Android a bit of pause. This will be all up to the decisions MS makes over the year, so we will see.

—Chris Heery

CUT, COPY, PASTE

A benchmark chart note on page 73 of the June 2014 of *Maximum PC* used the wrong system notes. It actually should have said the system was being compared to the same Kaveri system with Dual Graphics mode disabled.

Well, They'll Certainly Try

I heard that Time Warner and Comcast are adding data caps to their customers. The way it was explained, all Internet providers will follow suit and all Internet users will be capped. I found an article on the Maximum PC website that covered this topic, but it's two years old. Is this information accurate? Are we all going to have our Internet access limited by the cable companies?

—Adam Lynch

MANAGING EDITOR ALAINA YEE RESPONDS: Never underestimate what cable companies—and other large ISPs—will try to pull. Over the last couple of years, the big ISPs have toyed with bandwidth caps, but very few users outside those who gorge on bandwidth have really felt the effects of it.

So for now, the system for bandwidth caps is a bit haphazard and all over the map: AT&T, for example, imposes a 150GB cap on its old DSL plans but 250GB for their U-verse plans, while Verizon doesn't have one at all. Not all caps are enforced equally, either: Charter can opt to cut you off if you exceed your limit after the third warning, while Comcast has been testing a plan to charge $10 for every 50GB exceeded (and conversely, offer a discount to those who don't use very much bandwidth). It's best to check with your ISP directly to see what its current policies are, particularly as we move further and further into an era of bandwidth-eating activities.

A Lengthy Problem

I recently stopped using cheap power supplies for my computer—after going through two in the span of five years—and bought a quality PSU from Antec. It works great, but I never expected the 20-inch +/- cabling that apparently comes standard with most brand-name PSUs. It's ended up filling up my case with unneeded cabling, as my motherboard's power connector and devices are all 6–10 inches away. Are there any quality power supplies on the market with shorter cabling that you'd recommend? I have a Llano processor and no GPU, so my power needs are low. I'd love to have the 14-inch cabling back that I had on cheaper units.

—Matthew Jantz

ASSOCIATE EDITOR TOM MCNAMARA RESPONDS: If you need to reduce your cable clutter and you have no video card, you can cut things down quite a bit by going with a modular power supply. With these, you only need to attach the cables that you actually use. The rest can be stored nearby. Just don't lose them, because cables meant for other PSUs usually aren't compatible. As for specific options, the SeaSonic SSR-450RM is a high-caliber option with a 5-year warranty; if you're looking to save money, the Corsair CX430M is a good alternative.

↘ submit your questions to: comments@maximumpc.com

Plain English, Please

Can you describe the difference between the way GPUs and CPUs "think"? It seems that AMD is on the path to simply combine the two, and that left me wondering: if AMD's Radeon 290X is the best thing in the world for mining Bitcoins, why isn't it simply the best processor, even better than the best CPU? What is the fundamental difference between GPUs and CPUs that limits the role of each and prevents the two from competing directly as processing units?

—Isaac Peterson

> ARE WE ALL GOING TO HAVE OUR INTERNET ACCESS LIMITED BY THE CABLE COMPANIES?

EDITOR IN CHIEF GORDON MAH UNG RESPONDS: GPUs are inherently designed for doing a lot of similar, far simpler tasks in parallel. You know, like rendering graphics in a massively huge pipeline. A CPU is designed to handle far more different tasks that are often too complicated for even today's GPU's to handle.

One analogy that's often thrown around is that a CPU is a small group of very smart people. A GPU is a very large group of laborers that aren't as smart, but because there's so many of them, they'll accomplish the task faster. To put the scale in perspective—the Core i7-4770k is a quad-core part with Hyper-Threading for a total of eight threads of computing available. A Radeon 290X has 2,816 cores. CPUs are also designed to handle far more disparate duties than a GPU, such as managing the operating system and the tens of thousands of varied tasks the average computer does as you use it daily. A GPU is pretty much a massive collection of worker bees that can render graphics or, say, perform a certain kind of math very fast. But ask it to, say, run Microsoft Word or the Chrome browser, and you'll get a blank stare. It's simply not designed for such mundane tasks.

Nope, It's Not

Can software be tasted? Or, is "version" the word we're looking for instead of "flavors"?

—Chris Ajemian

MANAGING EDITOR ALAINA YEE RESPONDS: Just think how dreary life would be if we were only allowed to use the word "version" in every instance it applied; it'd be like living in a world with just one flavor. We're a Baskin Robbins kind of group here.

[NOW ONLINE]

GRAPHICS ANALYSIS: DARK SOULS 2

We know that you're probably equipped with a badass gaming rig—or on the cusp of acquiring one—so we wanted to give you a visual glimpse of what your system/future system might be able to handle when playing certain high-profile PC games. As a result, we've created a new feature called "Graphics Analysis," where we do a deep-dive into popular games and analyze its various graphical bells and whistles. In our inaugural article, we look at Dark Souls 2's low, medium, and high setting with comparison screenshots and videos. Check it out at http://bit.ly/MPC_gfx!

Facebook Polls

If you were a video card, what kind of video card would you be?

With so many different options around, there's got to be one that matches your personality perfectly. So we asked our Facebook crowd to let us know who they really are. Here are some of our favorite responses.

Hatsuyuki Kagirinai: Dual card, I could leave all the work for my friend and sleep.

Cris Smith: GTX Titan. Because I am overpriced, lazy, and can be matched in performance by someone from 2011.

Matthew Simpson: An Nvidia GeForce MX 200/400. Always reliable when you need something that'll work when your better video card quits on you.

Gerard Montgomery: I'd be a Voodoo 3. Cranky and unreliable.

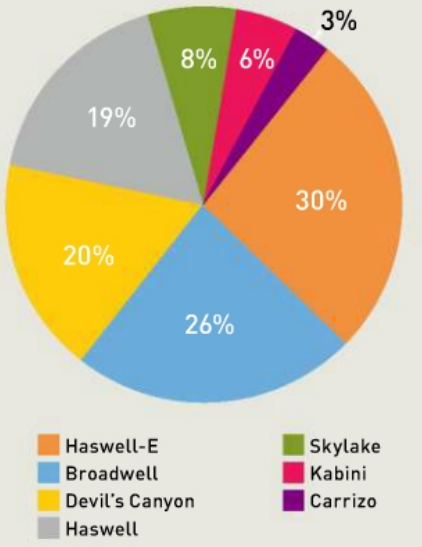
Dkaota Davis: The question is not what video card would I be, the question is what video card wants to be me.

Brian Keaney: In all honesty, I'd be a GTX 460. Like the card, I'm a little chubby, constantly run on the hot side, don't really have much speed, and tend to be unstable on my feet.

Simon Foex: I would be a Radeon R9 380. Because I have strong potential, but all the world knows about me is my name.

Levi Carlson: 8400. Because everyone falls for me, then regrets it.

What CPU upgrade are you looking forward to most?



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THE BUILDS

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INGREDIENTS

PART			PRICE
Case	Corsair Vengeance C70		$108
PSU	SeaSonic SSR-750RM 750W	NEW	$85
Mobo	Gigabyte GA-Z97X-UD5H	NEW	$180
CPU	Intel Core i5-4670K		$240
Cooler	Cooler Master Hyper 212 Evo		$35
GPU	MSI Radeon R9 280 Gaming 3G	NEW	$250
RAM	2x 4GB G.SKILL Ares Series F3-1600C9D-8GAO		$69
Optical Drive	Samsung SH-224DB/BEBE		$20
SSD	Samsung 840 EVO 250GB		$150
HDD	Seagate Barracuda 1TB		$65
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $1,302

PERFORMANCE

INGREDIENTS

PART			PRICE
Case	NZXT Phantom 530		$130
PSU	XFX P1-1050-BEFX 1050W	NEW	$180
Mobo	Asus Sabertooth X79		$320
CPU	Intel Core i7-4820K		$325
Cooler	Corsair H100i		$100
GPU	Gigabyte R9 290X GV-R929XOC-4GD	NEW	$550
RAM	4x 4GB G.SKILL Ripjaws F3-12800CL9Q 16GBRL		$150
Optical Drive	LG WH14NS40 Blu-ray Burner		$70
SSD	Samsung 840 Evo 500GB		$260
HDD	Seagate Barracuda 3TB		$110
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $2,295

AS THIS ISSUE went to press, we didn't have a "Devil's Canyon" CPU from Intel, which is a refresh of its Haswell generation. But we did have several motherboards that use Intel's new Z97 chipset. We chose the Gigabyte GA-Z97X-UD5H because of its balance of features, price, and performance. AMD card prices have stabilized, so we can now recommend an MSI Radeon R9 280, which consistently outperforms the GeForce GTX 760 at the $250 price point. Rosewill's Hive-750 PSU from last time was out of stock, but the SeaSonic SSR-750RM is modular, gold-rated, and competitively priced. The 550W model used in our February Build It (pg. 58) performed quite well.

THE NEXT VERSION of Intel's workstation CPU is still on the horizon, so we're staying with the Core i7-4820K. Unlike the build to the left, this LGA 2011 chip has enough PCI Express lanes to handle three or four video cards. Speaking of which, we've swapped the GeForce GTX 780 with a Radeon R9 290X, now that the price for the latter has returned to orbit. This Gigabyte model runs cool and quiet, it outperforms the 780 in most tests, and the price premium for that is pretty small. We've also switched our power supply to the XFX P1-1050-BEFX, since it costs just a little more than the Cooler Master Silent Pro M2 while offering much higher efficiency. There are cheaper SSDs than the Samsung 840 Evo, but we prefer its software.

ULTRA

COMPARED TO THE Intel Core i7-4820K on the previous page, this Core i7-4930K has an additional two cores, with Hyper-Threading giving us twelve processor threads, as opposed to eight. This is a nice boost for video encoding and live streaming, and some games are starting to use as many threads as we can give them. We've seen more than a few reports that users of the Cooler Master Glacer 240L CPU cooler have experienced some build-quality issues, so we've switched to the company's Glacer 280L. As its name implies, it has a 280mm radiator, giving it more surface area to dissipate heat, and it performed quite well when we reviewed it in the April issue.

Nvidia's GeForce GTX 780 and 780 Ti video cards have been a mainstay in the Ultra build for some time now, but we've been impressed with AMD's Radeon R9 295X2. It combines two R9 290X GPUs onto one card that uses an integrated liquid cooler. It runs very cool and quiet even when overclocked, though it is held back a little by a non-adjustable voltage.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART			PRICE
Case	Corsair Obsidian 900D		$320
PSU	XFX ProSeries 1,250W P1-1250-BEFX		$260
Mobo	Asus X79 Deluxe		$329
CPU	Intel Core i7-4930K		$580
Cooler	Cooler Master Nepton 280L	NEW	$125
GPU	Radeon R9 295X2	NEW	$1500
RAM	4x 4GB G.SKILL Ripjaws F3-12800CL9Q 16GBRL		$150
Optical Drive	LG WH14NS40 Blu-ray Burner		$70
SSD	Samsung 840 Evo 1TB MZ-7TE1T0BW		$450
HDD	Seagate 4TB Desktop HDD ST4000DM000		$160
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $4,044

UPGRADE OF THE MONTH
SABRENT EC-TB4P USB 3.0 HARD DRIVE ENCLOSURE

Now that solid-state drives are coming down in price, it's a good idea to start putting them in external enclosures for quick backups and transfers of large amounts of data. The EC-TB4P is not a new model from Sabrent, but it's earned a solid rep. **$18,** www.sabrent.com

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